

# UNIT-1

## INTRODUCTION OF ESTIMATING & COSTING

Definition:- Estimate can be defined as the procedure or method of working out the quantity & then calculating the cost at suitable rates. Estimating is the technique of the calculating or computing the quantities of particular work or project.

- ⇒ Before undertaking the construction of a project it is necessary to know its probable cost which is worked out by estimating. An estimate is a computation or calculation of the quantities required and expenditure likely to be incurred in the construction of a work.
- ⇒ The primary object of the estimate is to enable one to know beforehand, the cost of the work (buildings, structures etc).
- ⇒ The estimate is the probable cost of a work and is determined theoretically by mathematical calculations based on the plans and drawing and current rates.
- ⇒ Approximate estimate (may be) prepared by various methods but Accurate estimate is prepared by detailed Estimate Method.

Actual cost:- The actual cost of a work is known at the completion of the work. Account of all expenditure is maintained by day-to-day during the execution of work in the account section and at the end of the completion of the work when the account is completed, the actual cost is known. The actual cost should not differ much from the estimated cost worked out at the ~~in~~ beginning.



## Need / Purpose of Estimation :-

- 1) Estimate gives an idea of approximate cost of work.
- 2) To know the approximate quantity of various materials & labour required.
- 3) To have an idea about the time of completion of the work / Project.
- 4) For invite the tenders, quotations & to arrange the contract.
- 5) To justify the investment from benefit - cost ratio.
- 6) An estimate required for an existing property is needed to valuation.
- 7) It helps in financial planning to once before going to construction.
- 8) It is also required to control the expenditure during the execution of work.

## Types of estimate :-

- 1) Preliminary Estimate / Approximate / Rough Estimate :-
  - a) Plinth Area Rate estimate
  - b) Cube Rate estimate / cubical contents estimate
  - c) Service Unit estimate / Unit Base estimate
- 2) Detailed Estimate :-
  - a) Supplementary estimate
  - b) Revised estimate
  - c) Combination of supplementary estimate & Revised estimate.
  - d) Annual Repair or maintenance estimate
  - e) Complete estimate



## 1) Preliminary/Approximate/Rough Estimate

Approximate estimate is made to find out an approximate cost in a short time without taking out actual quantity. Preliminary estimate required various aspect of work or project to decide financial position & policy for administrative approval.

It is prepared from practical knowledge cost of the similar works. It contains the cost of all important items such as cost of land, cost of each building material, water supply & sanitary, Electrification & other services.

The accuracy of approximate estimate depends upon the judgement skill & experience of the estimator.

### Uses of Preliminary Estimation :-

- 1) To give rough idea of the probable cost
- 2) For administrative approval
- 3) For Valuation & Rent.

### Types of Approximate Estimate :-

- a) Plinth Area Rate Estimate
- b) Cube Rate Estimate / cubical contents estimate
- c) Service Unit Estimate / Unit Base estimate

#### a) Plinth Area Rate estimate :-

This estimate is prepared on the basis of Plinth Area of building. Plinth Area estimate is prepared by finding the plinth area of the building & multiply by the plinth Area rate.

$$\text{Cost of Building} = \text{Plinth Area} \times \text{Plinth area rate}$$



## b) Cube Rate estimate / Cubical Contents estimate :-

It is prepared on the basis of cubical content of the building i.e., length, width / Breadth & Height.

$$\text{Cost of Building} = \text{Total cubic Content} \times \text{Cost Per cube.}$$

## c) Service unit estimate / Unit Base estimate :-

Each building constructed, to some purpose e.g., 'Hostel' is designed to certain number of room each "Room" is then considered as service unit of the Hostel.

$$\text{Cost of Building} = \text{No. of service unit} \times \text{Rate of service unit}$$

<u>Types of Building</u>	<u>Service unit</u>
Hospital	Per Bed
Cinema Hall	Per Seat
Hostel	Per Room
Stadium	Per seat
School	Per class
Road	Per km length
Irrigation	Per Hectare Irrigation Area
Water supply & Sanitary	Per Person
Overhead Water Tank	Per liter
Bridge	Per span length
Canal	Per meter length
Dam	Per Hectare storage
Stable	Per Animal
Culvert	Per span length



## 2) Detailed Estimate

Detailed estimate includes quantities & cost of everything required for satisfactory completion of work & this is the best and most reliable estimate that can be made. Detailed estimate prepared in 2 stages.

- i) Measurement sheet (Quantity)
- ii) Abstract sheet (Cost)

### Uses of Detailed Estimation:-

- 1) To know the accurate cost of the project/work.
- 2) Quantities of various items of work are known.
- 3) To know the cost of each item of work/Project.
- 4) To invite the tender for a work.

### Types of Detailed Estimate:-

- a) Supplementary Estimate
- b) Revised estimate
- c) Combination of supplementary estimate & Revised estimate
- d) Annual Repair or Maintenance estimate.
- e) Complete estimate

#### a) Supplementary Estimate:-

It is a detailed estimate for additional items of the work needed were not included in original estimate. While work is in progress some additional work may be thought necessary for development of the project which not for seen when the original estimate was formed, an estimate is then prepared to cover up all such works which is known as "Supplementary estimate".

#### b) Revised Estimate:-

It is a detailed estimate which is prepared one of the following parameters -



- i) When original sanctioned estimate exceeds by more than 5%.
- ii) Expenditure on work exceeds or likely to exceed the administrative approval by more than 10%.
- iii) There are material deviation.

In revised estimate a comparative statement is prepared indicating variation of each of work, cost & rate under original and revised cost side by side showing excess or saving & reason for variation.

### c) Combination of Supplementary & Revised estimate:-

If before or after the execution of work it is found that the original estimate is excessive then competent authority sanctions a revised estimate & informs accountant generals also.

Revised estimate is required due to changes of rate or quantity of material or an addition or revision of drawings is necessary. Supplementary estimate is required due to some new works or change of design or addition or revision of drawing may be necessary.

### d) Annual Repair or Maintenance estimate:-

It is a detailed estimate which is prepared for the items which requires renewal, replacement, repaired etc. Annual repaired cost of building is 1-1.5% of the original cost of the building.

### e) Complete Estimate:-

This is an estimate cost of all items which are related to the work in addition to the main contract or to the detailed estimate. One may think that an estimate of a structure includes only the cost of land & the

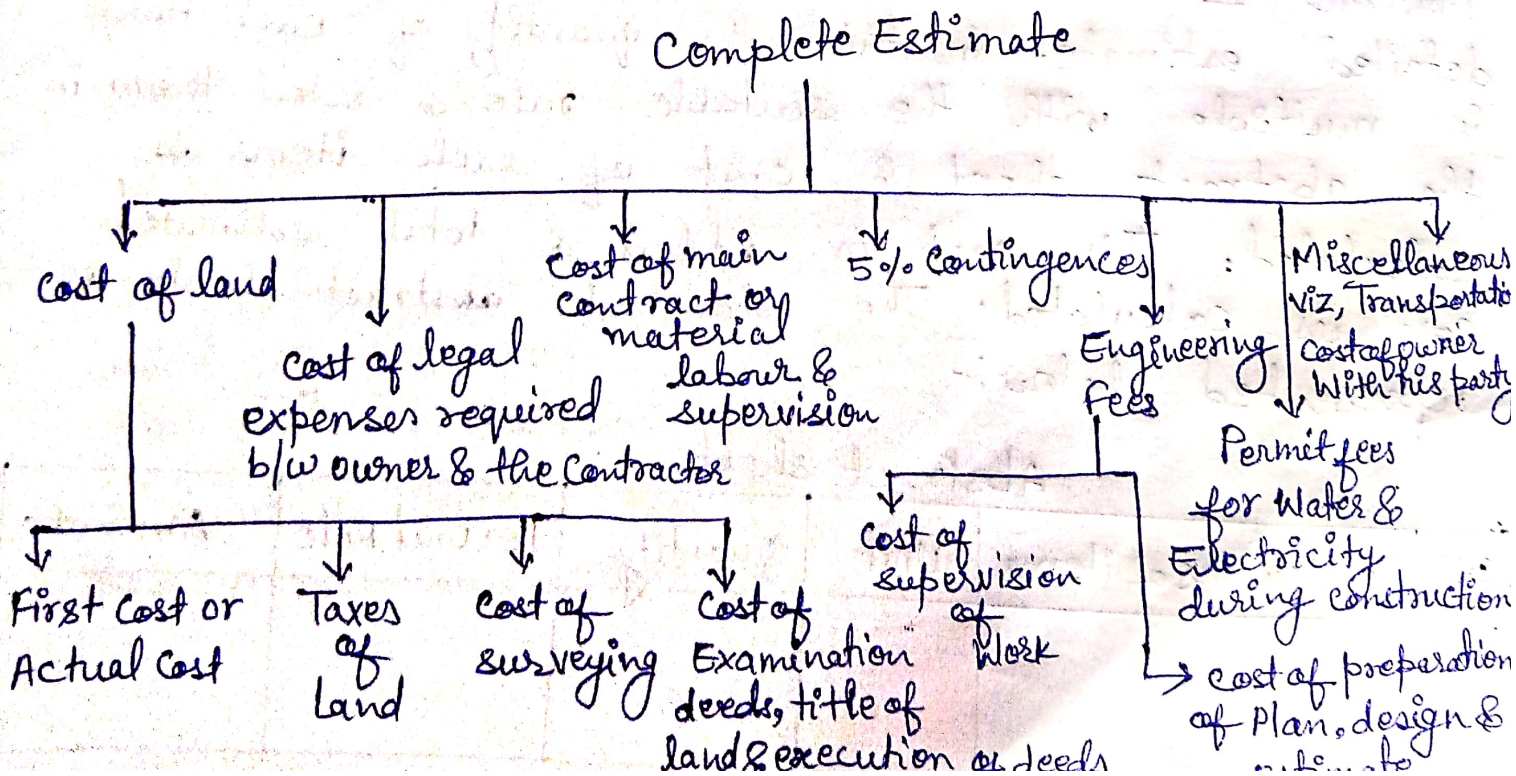


Cost of main contracts or labours, materials & supervision  
 But there are many other cost items to be included.

Procedure of Complete Estimate :-

- 1) Cost of land
  - a) First cost or Actual cost
  - b) Taxes of land
  - c) cost of surveying
  - d) Cost of examination deeds, title of land & execution of deeds.
- 2) Cost of legal expenses required between owner & the contractor.
- 3) Cost of main contract or material, labour & supervision.
- 4) 5% Contingences
- 5) Engineering Fees
  - a) cost of Preparation of Plan, Design & estimate
  - b) cost of supervision of work.
- 6) Permit fees for Water & Electricity during construction.
- 7) Miscellaneous viz, Transportation cost of owner with his Party

Flow diagram of Complete estimate with their steps





## Measurement Sheet

- Measuring the dimension i.e. length, width/Breath & Height or Depth of the various items of the construction from the drawing & note them in the particulars column of a standard measurement sheet. Then by multiplying dimensions of every item, quantities of all the items are marked out. It is used to prepared detailed estimate in first step. Measurement sheet is fixed out the quantity of items with the help of details of measurement. The standard measurement sheet as represented below:-

Standard Measurement sheet

S.N	Particulars of items	No.	Length	Width	Height	Quantity	Remark
1.							
2.							
3.							

## Abstract sheet

Abstract of estimated cost is the second part of the detailed estimate. In this the quantity of each items is multiple with the suitable rate & noted them in the abstract sheet & cost of each items is calculated. This cost is added & total estimated cost is calculated. The standard abstract sheet as represented below:-

Abstract sheet

S.N	Particulars of items	Unit	Quantity	Per unit Rate	Amount
1.					
2.					
3.					



The estimated cost is increased by 5% for any unexpected expenditure which is known as contingencies. Other additional expenses such as Contractor's Profit, Water charge, purchase of tools & equipment for big projects, insurance charges etc. are also worked out & added for arriving at final estimated cost.

# The main functions of an abstract of an estimate are as follows:-

- 1) The final estimated cost of the work can be known.
- 2) The bills of work done are also made on the basis of abstract of estimate.
- 3) The abstract of estimate produces a part of tender document from which a contractor can arrive at the total construction cost of a project after applying own rates.
- 4) It is the basis on which percentage tenders are called after excluding the amount of contingencies etc.
- 5) Relative cost of various items of works can also be known.
- 6) The different items of the work to be carried out to finish the project can also be known.
- 7) Usually the order of items of estimate is according to the progress of construction work. Hence there is small chance of omission of an item in the estimate.

### Material Consumption Statement Form

The material consumption report is a document used in the production process to summarize the goods or material used during a specific accounting period of project work. It is show how much raw material actually used.



Nature of Work-						Name of Project-							
S/N	Description	Qty of Work	Bricks		Cement		CS		Agg.		Steel	Steel	Remarks
			Nos/m <sup>3</sup>	Total Nos	Bag/m <sup>3</sup>	Total Nos	Qty/m <sup>3</sup>	Total Qty	Qty/m <sup>3</sup>	Total Qty	12mm Kg	10mm Kg	
1)	Concrete Work M20	5m <sup>3</sup>	Nil	Nil	8	5x8	0.441	0.441 x 5	0.882	0.882 x 5	-	-	
Total-													



## Methods of Building Estimate

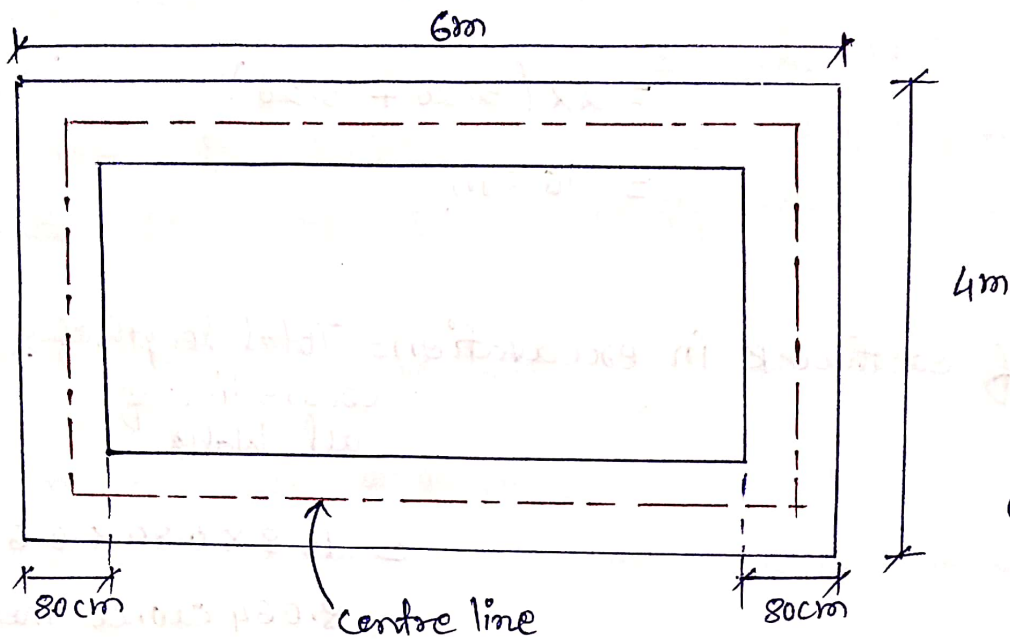
- 1) Centre line Method
- 2) "Long & Short Wall" or out to out & In-to-In" Method  
or separate or individual Wall Method
- 3) ~~Crossing~~ Method

1) Centre line Method :- In this method calculate the total centre line length of walls in a building and multiply the same by breadth and depth of respective item to get the total quantity at a time. For different sections of walls in a building, the centre line length for each type shall be worked out separately.

In case of partition or Verandah walls joining the main wall, the centre line length shall be reduced by half of the breadth of the layer of main wall that joins with the partition or Verandah wall at the same level.



Example (1) Figure represents plan and section of a trench which is 80cm wide & 60cm depth. It is required to calculate the volume of earthwork for the trench.



Given:-

$$\text{depth} = 60\text{cm} = 0.6\text{m}$$

Fig:- Plan

centre line for long wall = length of long wall - Half trench width from each side

$$= 6\text{m} - \frac{80\text{cm}}{2} - \frac{80\text{cm}}{2}$$

$$= 6\text{m} - 40\text{cm} - 40\text{cm}$$

$$= 6\text{m} - 0.4\text{m} - 0.4\text{m}$$

$$= 5.20\text{m}$$

centre line for short wall = length of short wall - Half trench width from each side

$$= 4\text{m} - \frac{80\text{cm}}{2} - \frac{80\text{cm}}{2}$$

$$= 4\text{m} - 40\text{cm} - 40\text{cm}$$

$$= 4\text{m} - 0.4\text{m} - 0.4\text{m}$$

$$= 3.20\text{m}$$



Thus, total length of centre line of all walls;

$$= 2 \times (\text{length of long wall} + \text{length of short wall})$$

$$= 2 \times (5.20 + 3.20)$$

$$= 16.8 \text{ m}$$

Volume of earthwork in excavation = Total length of centre line of all walls  $\times$  Width  $\times$  Depth

$$= 16.8 \times 0.80 \times 0.6$$

$$= 8.064 \text{ cumec metre.}$$

2) Long & Short Wall or out to out & In to In Method:-

In this method the longer walls in a building are considered as long walls and measured from out to out & the shorter or partition walls in a perpendicular direction of the long walls are considered as short walls and are measured from in to in for a particular layer of work. The length of long and short walls are multiplied separately by the breadth & height of the corresponding layer and are added to get the quantity.

- To calculate the lengths of long and short walls, determine first their centre to centre lengths individually from the plan.
- Then the length of long wall, out to out may be calculated after adding half breadth of wall



- at each end with its centre to centre length.
- Thus, the length of short wall measured into in may be find out after subtraction half breadth at each end from its centre to centre length
- length of long wall generally decreases from earthwork to brickwork in superstructure and in the case of short wall, its length increases

From centre line Method,

$$\begin{aligned}
 \text{centre line for long wall} &= 6\text{m} - \text{Half trench width from each side} \\
 &= 6\text{m} - \frac{80\text{cm}}{2} - \frac{80\text{cm}}{2} \\
 &= 6\text{m} - 0.4\text{m} - 0.4\text{m} \\
 &= 5.20\text{m}
 \end{aligned}$$

Now, length of long wall out-to-out = Centre line length of long wall + Half breadth from each side

$$\begin{aligned}
 &= 5.20\text{m} + \frac{80\text{cm}}{2} + \frac{80\text{cm}}{2} \\
 &= 5.20\text{m} + 0.40\text{m} + 0.40\text{m} \\
 &= 6\text{m}
 \end{aligned}$$

$$\begin{aligned}
 \text{Quantity for long walls} &= 2 \times L \times B \times H \\
 &= 2 \times 6 \times 0.80 \times 0.60 \\
 &= 5.76 \text{ cumec metre}
 \end{aligned}$$

$$\left. \begin{aligned}
 L &= 6\text{m} \\
 B &= 0.80\text{m} \\
 H &= 0.60\text{m}
 \end{aligned} \right\}$$

Now, centre line for short wall = length of short wall - Half trench width from each side

$$= 4 - \frac{80\text{cm}}{2} - \frac{80\text{cm}}{2}$$



$$= 4\text{m} - 0.40\text{m} - 0.40\text{m}$$

$$= 3.20\text{m}$$

Thus length for short wall, in-to-in =  $\frac{\text{centerline}}{\text{Short Wall}}$  length for -  $\frac{\text{Half trench}}{\text{from each side}}$

$$= 3.20\text{m} - \frac{80\text{cm}}{2} - \frac{80\text{cm}}{2}$$

$$= 3.20\text{m} - 0.4\text{m} - 0.4\text{m}$$

$$= 2.40\text{m}$$

$$\text{Quantity for short walls} = 2 \times L_s \times B \times H$$

$$= 2 \times 2.40 \times 0.80 \times 0.60$$

$$= 2.304 \text{ cu. m}$$

Total Quantity of earthwork in excavation,

$$= \text{Quantity for long walls} + \text{Quantity for short wall}$$

$$= 5.76 + 2.304$$

$$= 8.064 \text{ cu. m}$$

Q.1 Estimate the quantities of brick work and plastering required in a wall 4m long, 3m high and 30cm thick. calculate also the cost if the rate of brick work is Rs. 320.00 per cu. m and of plastering is Rs. 8.50 per sq. m.

Sol<sup>n</sup>

Given

$$L = 4\text{m}$$

$$H = 3\text{m}$$

$$t = 30\text{cm} = 0.3\text{m}$$

$$\begin{aligned} \text{Quantity of brickwork} &= L \times B \times H \\ &= 4 \times 3 \times 0.3 \\ &= 3.6 \text{ cu.m} \end{aligned}$$

$$\begin{aligned} \text{Quantity of plastering (two faces)} &= 2 \times (L \times H) \\ &= 2 \times (4 \times 0.3) \\ &= 24 \text{ sq.m.} \end{aligned}$$

$$\text{Cost of brick work} = 3.6 \times 320 = \text{Rs. } 1152.00.$$

$$\text{Cost of Plastering} = 24 \times 8.50 = \text{Rs. } 204.00$$

$$\begin{aligned} \text{Total cost} &= 1152.00 + 204.00 \\ &= \text{Rs. } 1356.00 \end{aligned}$$

Exa (2) Estimate by Prepare a detailed estimate of part of a wall of a building from the given plan and sections and general specifications.

- ① Foundation concrete shall be of lime concrete.
- ② Foundation and plinth shall be of 1st class brickwork in lime mortar.
- ③ Damp Proof course - 2.5mm c.c 1:1½:3 with water proofing compound.
- ④ Superstructure - 1st class brick work in lime mortar.
- ⑤ Wall finishing - Inside wall 12mm cement plastered 1:6 and white washed 3 coats.
- outside wall 12mm cement plastered 1:6 including 10cm below ground level and finished with two coats of colour wash over one coat of white washing.

Rates:- Assume local current rates.



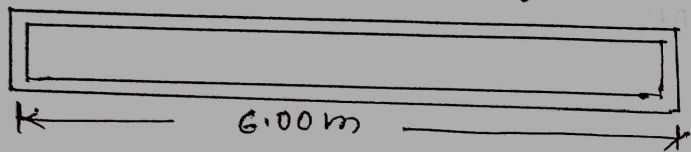
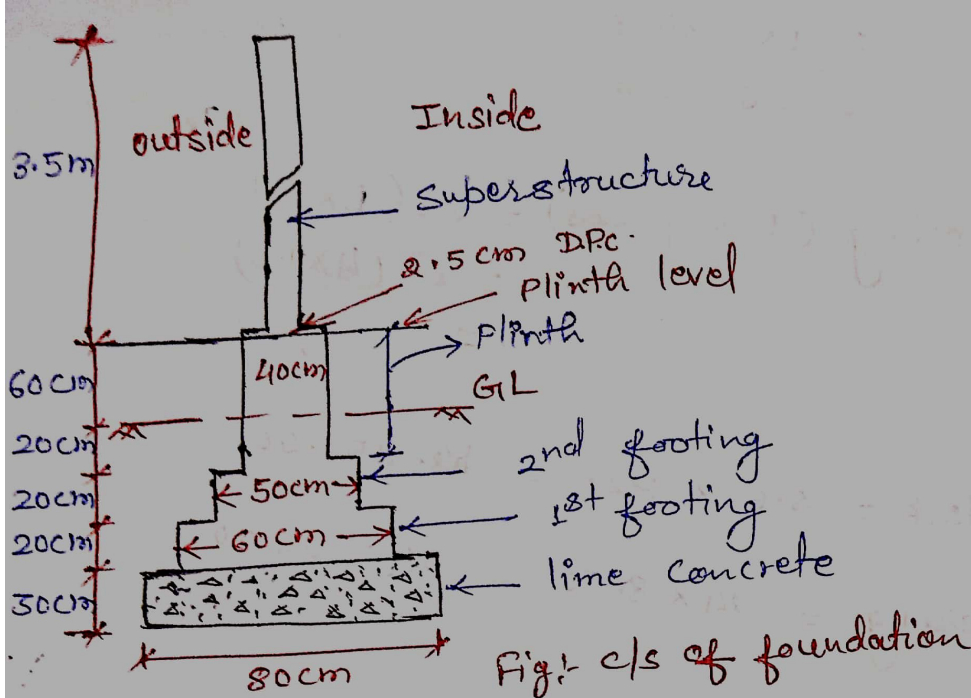


Fig:- Plan at Plinth By centre

Sol<sup>n</sup>:-  
Details of Measurement and calculation of quantities:-

Item No.	Description of items of work	No.	Length	Breadth	Ht. or Depth	Quantity	Total quantity
1)	Earthwork in excavation in Foundation	1	6m	.80m	.90m	4.32 cum	4.32 cum
2)	Lime concrete in foundation	1	6m	.80m	.30m	1.44 cum	1.44 cum
3)	1 <sup>st</sup> class Brickwork in lime mortar in foundation and plinth -						
	1 <sup>st</sup> footing	1	6m	.60m	.20m	.72 cum	} 3.24 cum
	2 <sup>nd</sup> footing	1	6m	.50m	.20m	.60 cum	
	Plinth wall	1	6m	.40m	.80m	1.92 cum	
4)	2.5cm Damp Proof Course (D.P.C.) c.c 1:1½:3	1	6m	.40m	—	2.4 sq.m	
5)	1 <sup>st</sup> class Brickwork in lime mortar for super structure	1	6m	.30m	3.50m	6.3 cum	6.3 cum

6)	12mm plaster of cement sand 1:6 - • Inside	1	6m	<del>3.5m</del>	3.5m	21.0 sq.m	} 46.2 sq.m
	• outside including 10cm below G.L	1	6m	—	4.20m	25.2 sq.m	
7)	White Washing 3 coats (Inside)	1	6m	—	3.50m	21.0 sq.m	21.05 sq.m
8)	Colour Washing 2 coats over one coat of white washing (outside above G.L)	1	6m	—	4.10m	24.6 sq.m	24.6 sq.m

### Abstract of estimated cost

Item No.	Description of Items of Work	Quantity	Unit	Rate (Rs.)	Per	Amount (Rs.)
1)	Earthwork in excavation in foundation	4.32	cum	350.00	% cum	15.12
2)	Lime concrete in foundation with	1.44	cum	220.00	per cum	316.80
3)	1st class Brickwork in lime Mortar in foundation & Plinth	3.24	cum	300.00	per cum	972.00
4)	2.5cm Damp Proof Course (D.P.C) C.C 1:1½:3	2.4	sq.m	20.00	per sq.m	48.00
5)	1st class Brick Work in lime mortar for superstructure	6.3	cum	320.00	Per cu.m	2016.00
6)	12mm plaster of cement sand 1:6 (Inside & outside)	46.2	sq.m	8.50	Per sq.m	392.70
7)	White Washing 3 coats (inside)	21.0	sq.m	0.75	Per sq.m	15.75
8)	Colour Washing 2 Coats over one coat of white Washing (outside above G.L)	24.6	Sq.m	0.82	Per sq.m	20.17

Total = 3796.54

Add for 3% Contingencies = 113.90

Add for Workcharged establishment 2% = 75.93

**Total cost - Rs. 3986.37**



Exa (3) Below fig, the plan represents the plan of superstructure wall of a single room building of 5m x 4m and sections represent the c/s of the walls with foundation.

- Estimate the quantities of -
- i) Earthwork in excavation in foundation
  - ii) Concrete in foundation
  - iii) Brickwork in foundation and plinth
  - iv) Brickwork in superstructure.

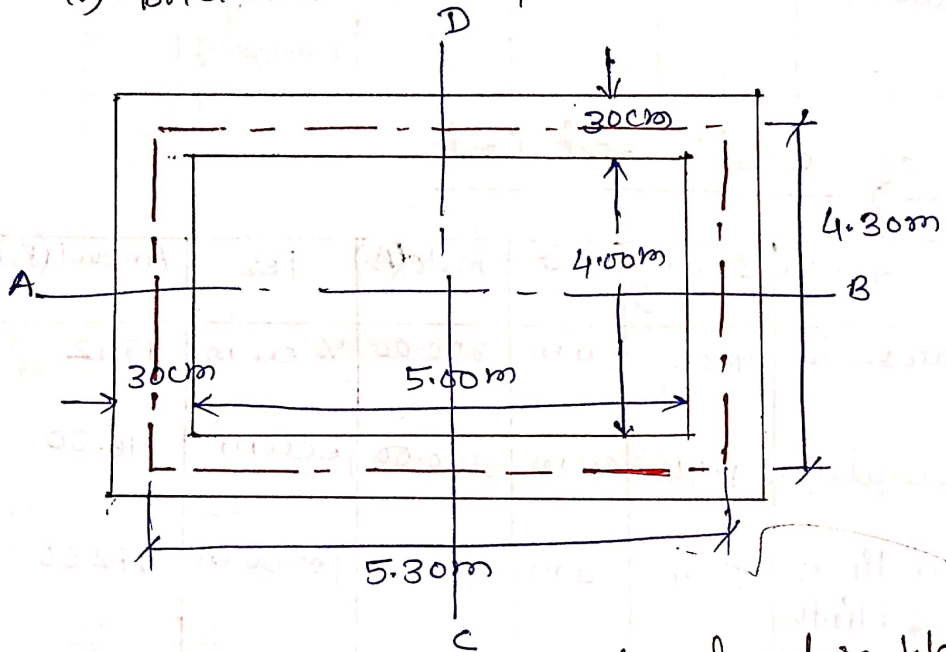


Fig:- Plan of superstructure wall

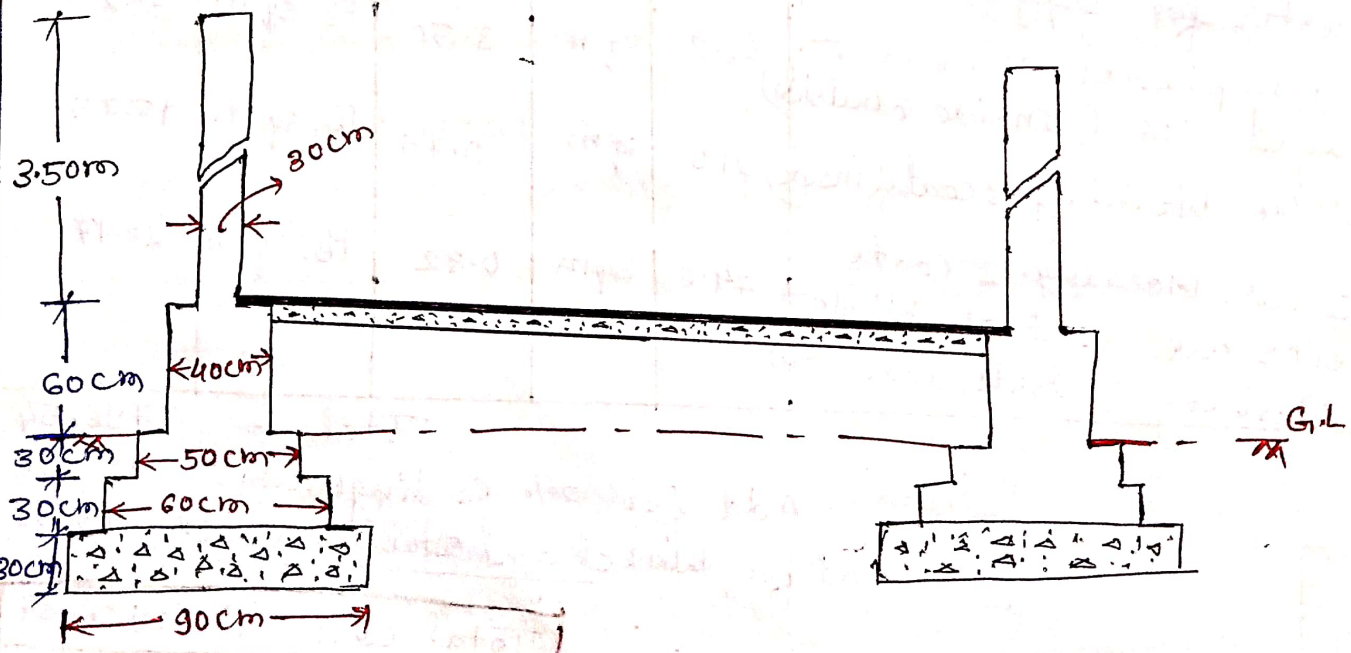


Fig:- Section AB

Sol.<sup>n</sup>:- By long Wall & short Wall Method :-

centre to centre length of long wall = 5.30 m  
 $\Rightarrow$  length of long wall = 5.30 m + Half breadth from each side.

centre to centre length of short wall = 4.30 m  
 $\Rightarrow$  length of short wall = 4.30 m - Half breadth from each side

Details of Measurement and calculation of quantities:-

Item No.	Particular of Item	No.	L(m)	B(m)	H(m) OR D(m)	Quantity	Explanatory Notes		
1)	Earthwork in excavation in foundation - • long wall (L <sub>E</sub> ) • short wall (L <sub>S</sub> )	2	6.20	.90	.90	10.04 cum	L <sub>E</sub> = 5.30 + .45 + .45 = 6.20 m L <sub>S</sub> = 4.30 - 0.45 - 0.45 = 3.40 m		
		2	3.40	.90	.90	5.51 cum			
						Total		15.55 cum	
2)	Concrete in foundation - • long wall • short wall	2	6.20	.90	.30	3.35 cum	length same as for excavation		
		2	3.40	.90	.30	1.83 cum			
						Total		5.18 cum	
3)	Brickwork in foundation & Plinth • long wall :- → 1 <sup>st</sup> footing → 2 <sup>nd</sup> footing → Plinth Walls • Short walls :- → 1 <sup>st</sup> footing → 2 <sup>nd</sup> footing → Plinth Walls	2	5.90	.60	.30	2.13 cum	L = 5.30 + 0.6 = 5.9 m		
		2	5.80	.50	.30	1.74 cum	L = 5.30 + 0.5 = 5.8 m		
		2	5.70	.40	.60	2.74 cum	L = 5.30 + .40 = 5.7 m		
		2	3.70	.60	.30	1.33 cum	L = 3.4 - 0.6 = 3.7 m		
		2	3.80	.50	.30	1.14 cum	L = 3.4 - .5 = 3.8 m		
		2	3.90	.40	.60	1.87 cum	L = 3.4 - .4 = 3.9 m		
						Total	10.95 cum		
		4)	Brickwork in super structure • Long Wall • Short Wall	2	5.6 m	.30	3.5	11.76 cum	L = 5.30 + .30 = 5.6 m
				2	4 m	.30	3.5	8.40 cum	L = 4.30 - .3 = 4 m
						Total	20.16 cum		



# Abstract of estimated cost

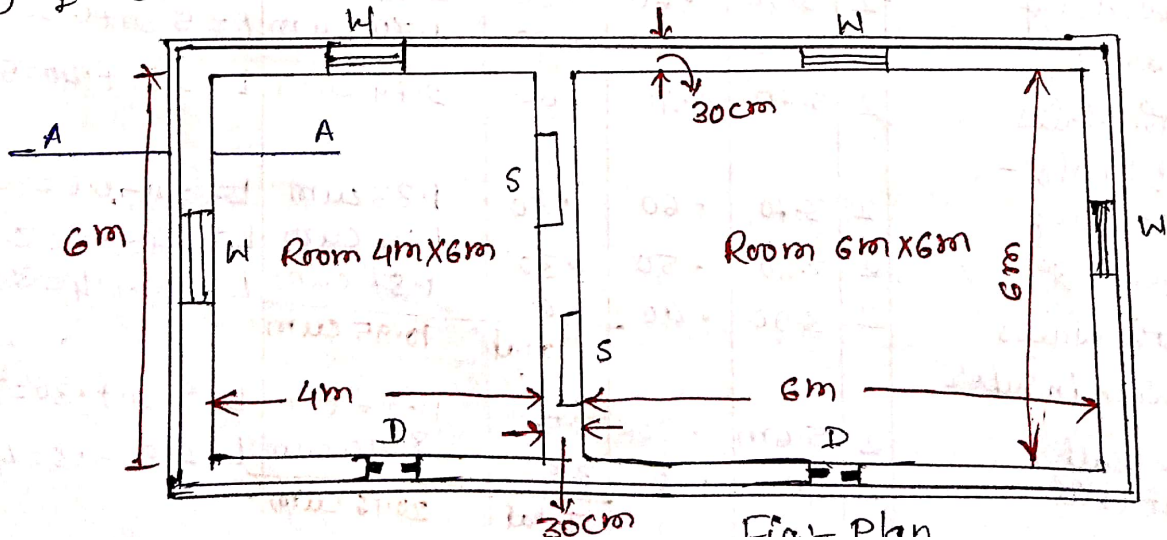
Item No.	Description of Items of Work	Quantity	Unit	Rate (Rs)	Per	Amount (Rs)
1)	Earthwork in excavation in foundation	15.55	cum	350.00	% cum	54.43
2)	Concrete in foundation	5.18	cum	220.00	per cum	1139.6
3)	Brickwork in foundation & plinth	10.95	cum	300.00	per cum	3285
4)	Brickwork in superstructure	20.16	cum	320.00	per cum	6451.2
Total						10930.23
Add for contingencies 3%						327.90
Add for work charged 2%						218.60

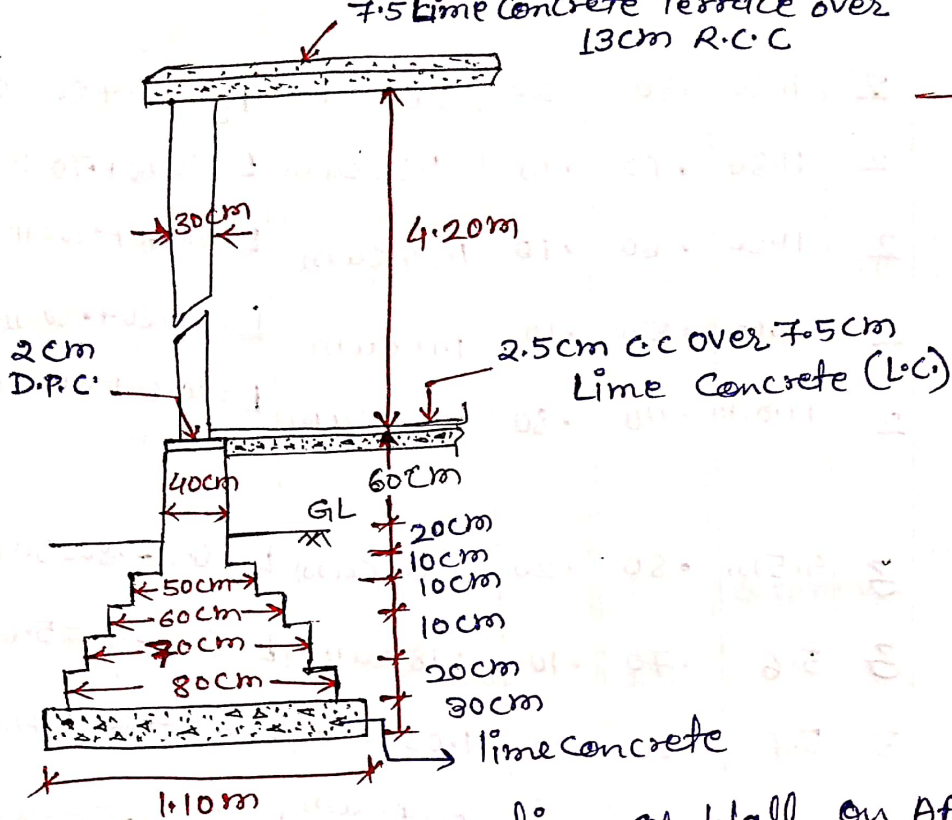
Grand Total = 11476.73

Grand Total = Rs. 11476.73

Q.4 Estimate the quantities of the following items of a two roomed building from the given plan and section.

- i) Earthwork in excavation in foundation
- ii) Lime concrete in foundation
- iii) 1st class brickwork in cement mortar 1:6 in foundation & plinth.
- iv) 2.5cm cc damp proof course
- v) 1st class brick work in lime mortar in superstructure.





Note: • All Walls are of same section  
 • lintels over Doors, Windows and shelves are 15cm thick R.B (Reinforced Brickwork)

- Doors D-1.20m X 2.10m
- Windows W-1.00 X 1.50m
- Shelves S-1.00m X 1.50m

Fig:- cross section of wall on AA

Sol. no:- length of long wall etc =  $6 + 4 + 0.30 + 0.15 + 0.15 = 10.60m$

length of short wall etc =  $6 + 0.15 + 0.15 = 6.30m$

Details of Measurement and calculation of quantities:-

Item No.	Particular of Items	No.	Length (m)	Breadth (m)	Height (m)	Quantity	Explanatory Notes
1)	Earthwork in excavation in foundation. • long walls • short walls	2	11.70m	1.10m	1.00m	25.74 cum	$L = 10.60 + \frac{1.10}{2} + \frac{1.10}{2} = 11.70m$ $L_s = 6.30 + \frac{1.10}{2} - \frac{1.10}{2} = 5.2m$
		3	5.20m	1.10m	1.00m	17.16 cum	
		Total		42.9 cum			
2)	Lime Concrete in foundation • long walls • short walls	2	11.70	1.10	.30	7.72 cum	
		3	5.20	1.10	.30	5.15 cum	
		Total		12.87 cum			
3)	1st class brickwork in 1:6 cement mortar in foundation & plinth :-						



Long Walls:-

- 1st footing
- 2nd footing
- 3rd footing
- 4th footing
- Plinth wall

2	11.40	.80	.20	3.65 cum	$L = 10.60 + .80 = 11.40m$
2	11.30	.70	.10	1.58 cum	$L = 10.60 + .70 = 11.30m$
2	11.20	.60	.10	1.34 cum	$L = 10.60 + .60 = 11.20m$
2	11.10	.50	.10	1.11 cum	$L = 10.60 + .50 = 11.10m$
2	11.00m	.40	.80	7.04 cum	$L = 10.60 + .40 = 11.00m$

Short Walls:-

- 1st footing
- 2nd footing
- 3rd footing
- 4th footing
- Plinth wall

3	5.5m	.80	.20	2.64 cum	$L_s = 6.30 - .80 = 5.5m$
3	5.6	.70	.10	1.18 cum	$L = 6.30 - .70 = 5.6m$
3	5.7	.60	.10	1.03 cum	$L = 6.30 - .60 = 5.7m$
3	5.8	.50	.10	0.87 cum	$L = 6.30 - .50 = 5.8m$
3	5.9	.40	.80	5.66 cum	$L = 6.30 - .40 = 5.9m$

Total 26.10 cum

1) Damp Proof Course  
2.5cm thick C.C.:-

- Long wall
- Short wall

2	11m	.40m	—	8.80 sq.m
3	5.9m	.40m	—	7.08 sq.m

Total 14.92 sq.m

Deduct:-

2) 1st class brick work in lime mortar in super-structure:-

- Long walls
- Short walls

2	10.90	.30	4.20	27.47 cum	$L = 10.60 + .30 = 10.90m$
3	6m	.30	4.20	22.68 cum	$L_s = 6.30 - .30 = 6.00m$

Total 50.15 cum

Deduct:-

- Door openings
- Window openings
- Shelves

2	1.20	.30	2.10	1.51 cum
4	1m	.30	1.50	1.80 cum
2	1m	.20	1.50	0.60 cum
2	1.5m	.30	.15	0.14 cum
4	1.3m	.30	.15	0.23 cum
2	1.3m	.30	.15	0.12 cum

Back of shelves 10cm thick wall

$L = s + 2t$   
 $= 1.20 + 2 \times .15$   
 $= 1.50m$

- lintels over doors
- lintels over window
- lintels over shelves.

Total of deduction = 50.15 - 4.40  
Net Total = 45.75 cum

Q. 5) Estimate by centre line method the quantities of the following items of single room building given in diagram

- ① Earthwork in excavation in foundation
- ② Concrete in foundation
- ③ Brickwork in foundation and plinth.
- ④ Brickwork in superstructure.

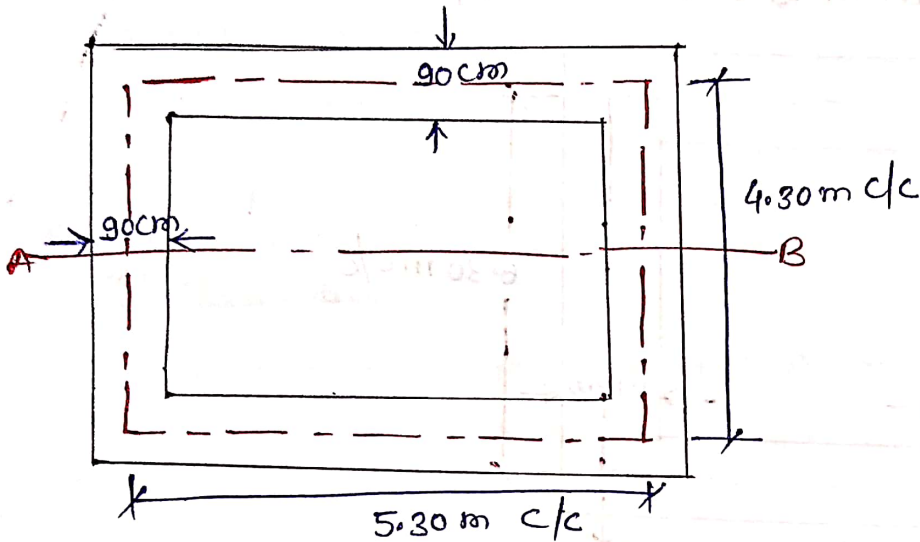


fig:- Plan

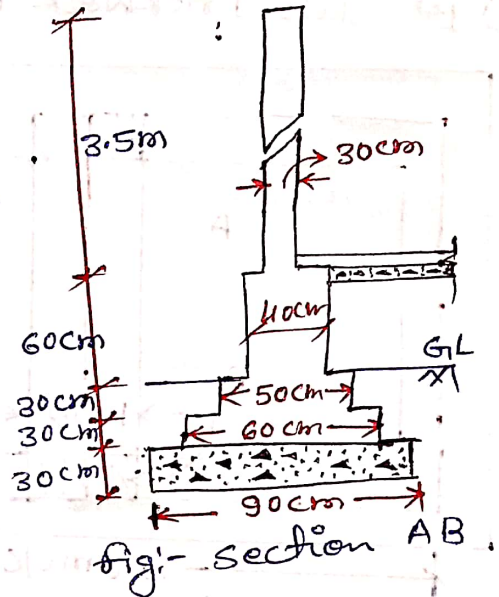


fig:- section AB.

Sol:<sup>n</sup>:- By centre line Method:-

$$\text{Total centre to centre length} = 5.30 + 5.30 + 4.30 + 4.30 = 19.20 \text{ m}$$

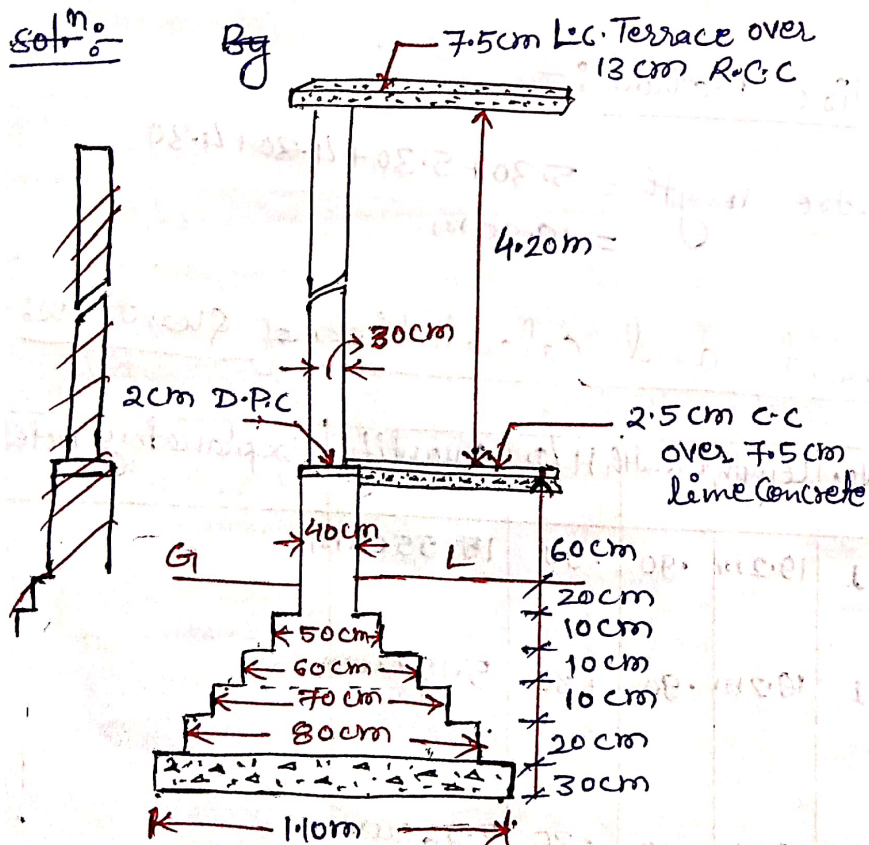
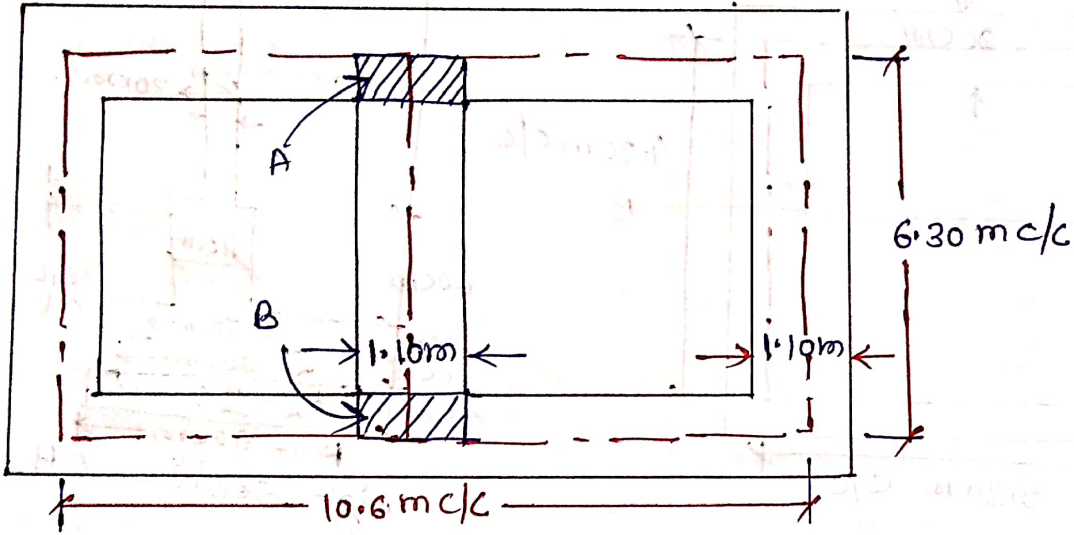
Details of Measurement and calculation of quantities:-

Item No.	Description of Items	No.	Length	Breadth	H/P	Quantity	Explanatory Notes
1)	Earthwork in excavation in foundation	1	19.2m	.90	.90	15.55 cum	
2)	Concrete in foundation	1	19.2m	.90	.30	5.18 cum	
3)	Brickwork in foundation and plinth.	1st footing	19.2m	.60	.30	3.46 cum	
		2nd footing	19.2m	.50	.30	2.88 cum	
		Plinth Wall	19.2m	.40	.60	4.61 cum	
				Total		10.95 cum	
4)	Brickwork in super-structure	1	19.2m	.30	3.5m	20.16 Cum	



Q6 Estimate by centre line method the quantities of the following items of a two roomed building:-

- i) Earthwork in excavation in foundation.
- ii) Lime concrete in foundation
- iii) 1<sup>st</sup> class brickwork in cement mortar 1:6 in foundation and Plinth
- iv) 2.5cm c/c damp proof course
- v) 1<sup>st</sup> class brickwork in lime mortar in superstructure.



Sol<sup>n</sup>:- By centre line Method

$$\text{Total centre length of Wall} = 2 \times 10.60 + 3 \times 6.30 = 40.10 \text{ m}$$

Note:- In this problem, if the total centre length is multiplied by the breadth and depth, at the junction the portion A and B shown by hatch line come twice, and we get the quantity in excess by these portions, and these excess shall have to be deducted. The deduction may be effected reducing the centre length by half breadth for each junction.

$$\begin{aligned} \text{Total centre length of Wall} &= 40.10 - 2 \times \frac{\text{Breadth}}{2} \\ &= 40.10 - 2 \times \frac{1.10}{2} \\ L &= 39.00 \text{ m} \end{aligned}$$

Quantity of earthwork in excavation:-

$$\begin{aligned} &= L \times B \times \text{depth} \\ &= 39 \times 1.10 \times 1.00 = 42.90 \text{ cu.m} \end{aligned}$$

Details of Measurement and calculation of quantities:-

Item No.	Particulars of Items	No.	L	B	H/D	Quantity	Explanatory Notes
1)	Earthwork in excavation in Foundation	1	39	1.10	1.0 m	42.90 cu.m	$L = 40.10 - 2 \times \frac{1.10}{2}$ $L = 39.00 \text{ m}$
2)	lime concrete in foundation	1	39	1.10	0.30 m	12.87 cu.m	
3)	1 <sup>st</sup> class Brick Work in 1:6 cement mortar in foundation and plinth						
	• 1 <sup>st</sup> footing	1	39.3	0.80	0.2 m	6.28 cu.m	$L = 40.10 - 2 \times \frac{0.80}{2} = 39.3$
	• 2 <sup>nd</sup> footing	1	39.4	0.70	0.10 m	2.76 cu.m	$L = 40.10 - 2 \times \frac{0.70}{2} = 39.4$
	• 3 <sup>rd</sup> footing	1	39.5	0.60	0.10 m	2.37 cu.m	$L = 40.10 - 2 \times \frac{0.60}{2} = 39.5$
	• 4 <sup>th</sup> footing	1	39.6	0.50	0.10 m	1.98 cu.m	$L = 40.10 - 2 \times \frac{0.50}{2} = 39.6$
	• Plinth Wall	1	39.7	0.40	0.80 m	12.70 cu.m	$L = 40.10 - 2 \times \frac{0.40}{2} = 39.7$
						T.L.D	26.10 cu.m



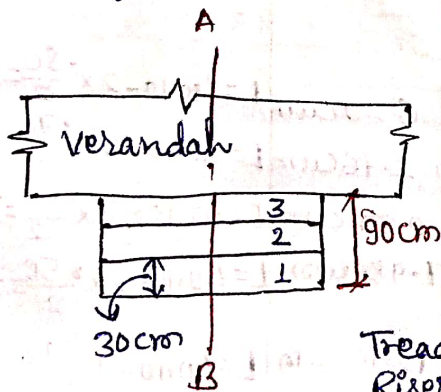
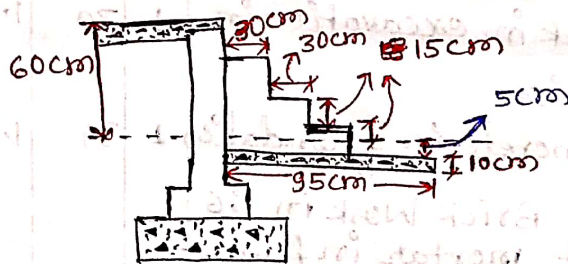
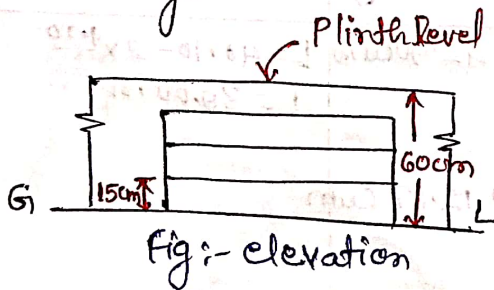
4. Damp proof Course 2.5cm c.c	1	39.7	.40	—	15.88 cum	$L = 40.10 - 2 \times \frac{40}{2} = 39.7m$
Deduct door sill	2	1.2m	.40	—	0.96 cum	
				Total	14.92 cum	
5. 1 <sup>st</sup> class brick-work in lime mortar in super structure.	1	39.8	.30	4.2	50.15	$L = 40.10 - 2 \times \frac{30}{2} = 39.80m$
<u>Deduct:</u>						
• Door openings	2	1.20	.30	2.10	1.51 cum	
• Window openings	4	1.0m	.30	1.50	1.80 cum	
• Shelves	2	1.0m	.20	1.50	0.60 cum	Back of shelves 10cm thick wall.
• Lintels over doors	2	1.5	.30	.15	0.14	
• Lintels over windows	4	1.30	.30	.15	0.23	
• Lintels over shelves	2	1.30	.30	.15	0.12	

Total of deduction = 4.40 cum

Net Total = 45.75 cum

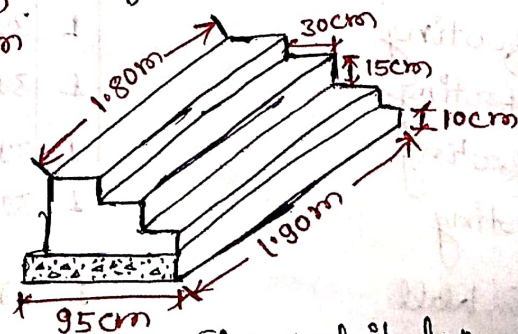
## Estimating of steps

Q1 Estimating the quantities of earthwork, concrete, Brickwork & Finishing work of different types of steps from given drawings.



Treads = 30cm  
Risers = 15cm

Treads = 30cm  
Risers = 15cm



# Details of Measurement & calculation of quantities

Items No.	Particular Work	Item of No.	L	B	H/D	Quantity
1)	Earthwork in excavation	1	1.90	.95	.15	.27 cum
2)	Concrete in foundation	1	1.90	.95	.10	.18 cum
3)	Brickwork - 1st step	1	1.80	.90	.20	.324 cum
	2nd step	1	1.80	.60	.15	.162 cum
	3rd step	1	1.80	.30	.15	.081 cum
						<u>Total = 0.567 cum</u>
4)	Finishing 20cm cement plastered					
	• Treads	3	1.80	.30	—	1.62 sq.m
	• Risers	4	1.80	—	.15	1.08 sq.m
	• Ends	2	.90	—	.15	.27 sq.m
						<u>Total = 3.24 sq.m</u>

## # Estimate of Three sides step:-

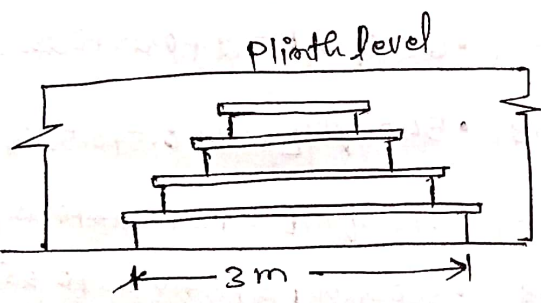


Fig:- Elevation

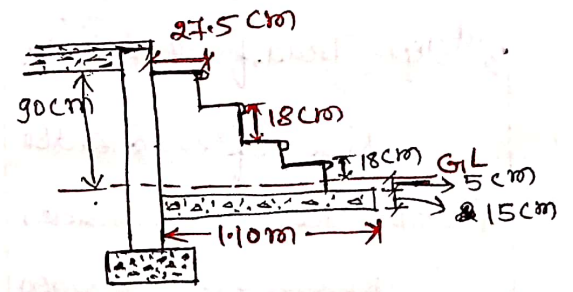


Fig:- Section 'AB'

Risers = 18cm  
Treads = 27.5cm including 2.5cm Nosing

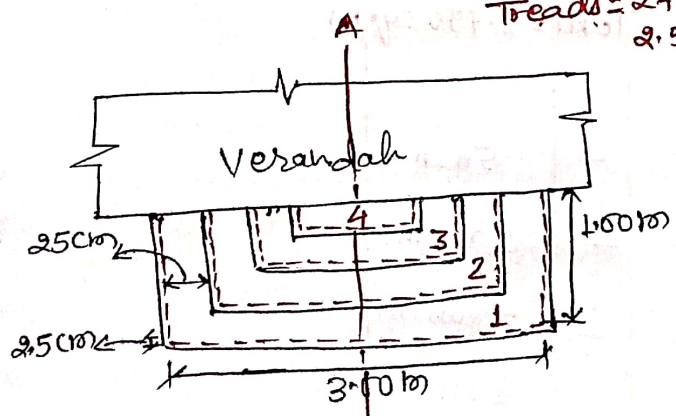


Fig:- Plan

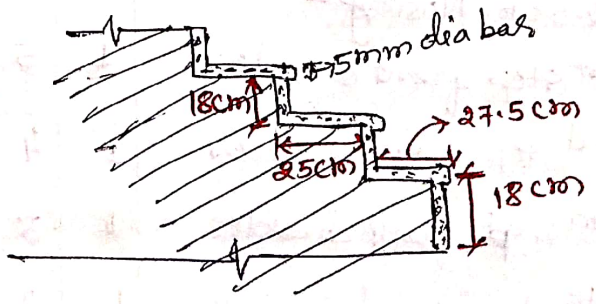


Fig:- Details of Nosing

• Surface of steps is provided with 2.5cm C.C 1:1½:3 finished with neat cement



# Details of Measurement and Calculations of quantities

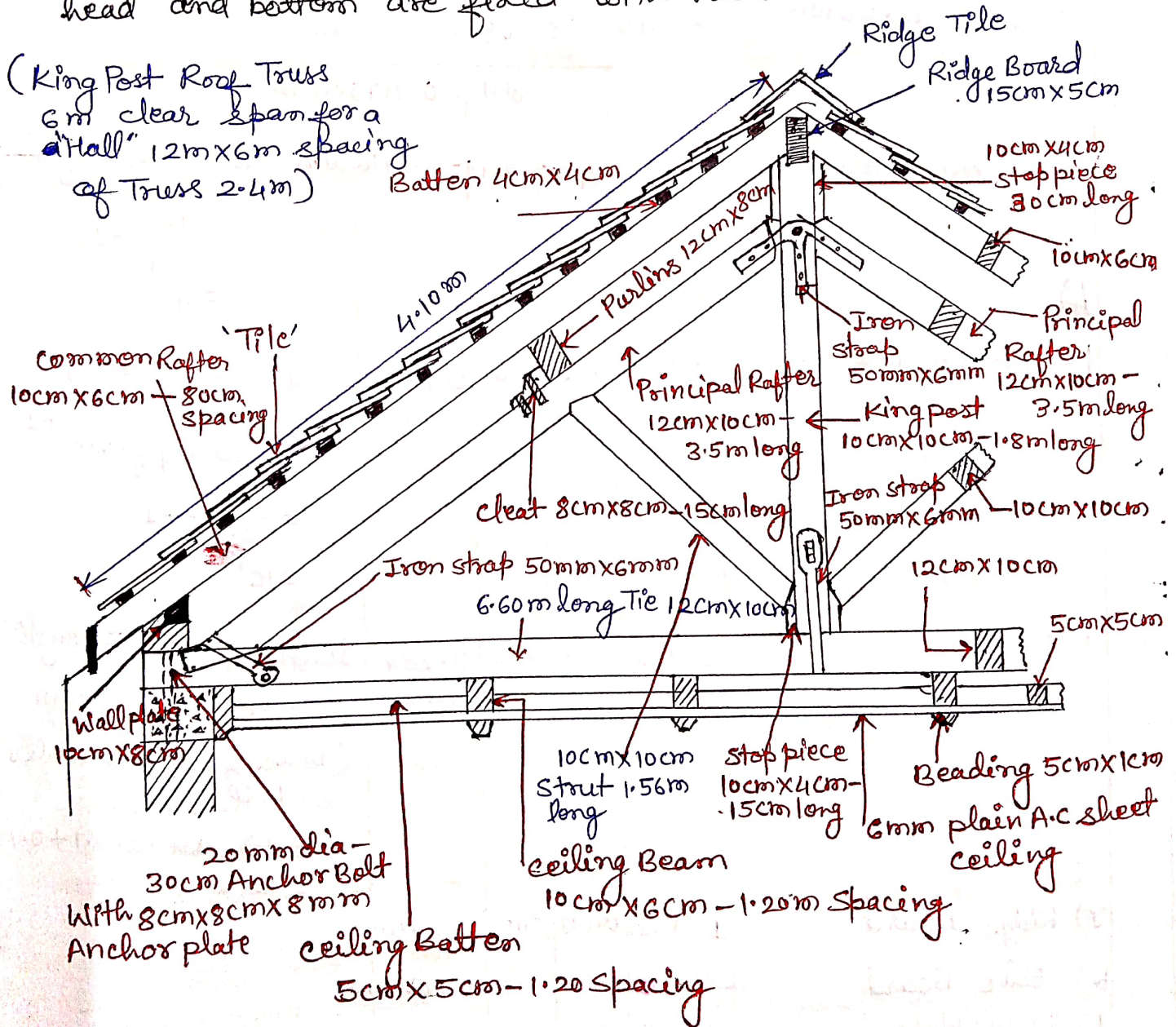
Item No.	Particulars Item of Work	No.	L	B	H/D	Quantity	Explanatory Notes
1)	Earthwork in excavation	1	3.20	1.10	.20	.71 cum	Take L = 3 + .10 + .10 L = 3.20 m
2)	Concrete in foundation	1	3.20	1.10	.15	.53 cum	
3)	Brickwork - 1 <sup>st</sup> step	1	3.00	1.00	.23	.690 cum	L = 3 m
	2 <sup>nd</sup> step	1	2.5	.75	.18	.338 cum	L = 3 - 0.25 - 0.25 = 2.5 m B = 1 - 0.25 = 0.75
	3 <sup>rd</sup> step	1	2	.5	.18	.180 cum	L = 3 - 0.5 - 0.5 = 2 m B = 1 - 0.5 = 0.5
	4 <sup>th</sup> step	1	1.5	.25	.18	.068 cum	L = 3 - 0.75 - 0.75 = 1.5 m B = 1 - 0.75 = 0.25
						Total = 1.276 cum	
4)	2.5 cm C.C 1:1½:3 in surface finishing						
	1 <sup>st</sup> step - Tread, front & sides	1	4.5	.25	-	1.125 sq. m	L = 3 + 0.75 + 0.75 = 4.5 m
	Risers, front & sides	1	5 m	-	.18	.900 sq. m	L = 3 + 1 + 1 = 5 m
	2 <sup>nd</sup> step - Tread, front & sides	1	3.5	.25	-	.875 sq. m	L = 2.5 + 0.5 + 0.5 = 3.5
	Risers, front & sides	1	4	-	.18	.720 sq. m	L = 2.5 + 0.75 + 0.75 = 4 m
	3 <sup>rd</sup> step - Tread, front & sides	1	2.5	.25	-	.625 sq. m	L = 2 + 0.25 + 0.25 = 2.5
	Risers, front & sides	1	3	-	.18	.540 sq. m	L = 2 + 0.5 + 0.5 = 3
	4 <sup>th</sup> step - Tread, front & sides	1	1.5	.25	-	.375 sq. m	L = 1.5 + 0.25 + 0.25 = 2 m
	Risers, front & sides	1	2	-	.18	.360 sq. m	L = 1.5 + 0.25 + 0.25 = 2 m
	Plinth - Risers	1	1.5	-	.18	.270 sq. m	
						Total = 5.790 sq. m	
5)	2.5 cm Nosing -						
	1 <sup>st</sup> step front & sides	1	5	-	-	5 run. m	
	2 <sup>nd</sup> step front & sides	1	4	-	-	4 run. m	
	3 <sup>rd</sup> step front & sides	1	3	-	-	3 run. m	
	4 <sup>th</sup> step front & sides	1	2	-	-	2 run. m	
						Total = 14 running m	



Ex. (5) Prepare a detailed estimate of the roof of a hall 12m x 6m having tiled roof over a wooden kingpost truss and purlins, rafters and battens of sal wood from the given drawing. The spacing of the truss are 2.4m and the ends will be provided with gable walls. Asbestos cement sheet (A.C. sheet) ceiling with plain A.C. sheet 6mm thick with wooden beadings supported with wooden ceiling beams and battens, shall be provided. All timber work and ceiling shall be provided with the coats of painting over one coat of priming.

The king post of 10cm section with stop pieces at the head and bottom are fixed with nails.

(King Post Roof Truss  
6m clear span for a  
Hall 12m x 6m spacing  
of Truss 2.4m)



Sol.<sup>n</sup>:-



# Details of Measurement and Calculation of quantities :-

Item No.	Particulars of Items & details of Works	No.	L	B	H/D	Quantity	Explanatory Notes
1)	Sal Wood Work						
	a) Principal Rafter	2	3.5	0.10	0.12	0.084 cum	
	b) strut	2	1.56	0.10	0.10	0.031 cum	
	c) King Post	1	1.80	0.10	0.10	0.018 cum	
	d) Tie beam	1	6.60	0.10	0.12	0.079 cum	
	e) stop piece at top	2	0.30	0.10	0.04	0.002 cum	
	f) stop piece at bottom	2	0.15	0.10	0.04	0.0012 cum	
	g) cleats for purlin	2	0.15	0.08	0.08	0.0019 cum	
						Total = 0.2179 cum	
	Total Wood Work for 4 Trusses					4 x 0.2179 = 0.8716 cum	No. of Truss = $\frac{\text{length}}{\text{spacing}} - 1$ $= \frac{12}{2.4} - 1$ $= 4$
	h) Common Rafter	2x16	4.10	0.06	0.10	0.787 cum	No. of Common Rafter, $= \frac{\text{length of roof}}{\text{spacing of rafter}} + 1$ $= \frac{12}{0.8} + 1$ $= 16$
	i) Purlin	2	12.2	0.08	0.12	0.234 cum	length of Purlin = length of roof + 0.10m + 0.10m (bearing on gable walls on both sides) $= 12 + 0.1 + 0.1$ $= 12.2 m$
	j) Ridge Board	1	12.2	0.05	0.15	0.091 cum	
	k) Eave Board	2x1	12.2	0.025	0.20	0.122 cum	
	l) Wall Plate	2	12.2	0.10	0.08	0.195 cum	
	m) Battens	14x2	12.2	0.04	0.04	0.546 cum	
	n) ceiling Beams	2x3	12.2	0.06	0.10	0.439 cum	



o) Ceiling Battens	11	5.64	0.05	0.05	0.155 cum	No. of battens, $= \frac{\text{length of roof}}{\text{spacing}} + 1$ $= \frac{12}{1.2} + 1$ $= 11$ Length of ceiling battens, $= \text{clear span} - (\text{No. of beam} \times \text{width of beam})$ $= 6 - (6 \times 0.06)$ $= 5.64 \text{ m}$
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# There are two Methods of detail estimate to calculate the estimate:-

- 1) Unit Quantity Method
- 2) Total Quantity Method

### 1) Unit Quantity Method

In unit quantity method the work is divided into various items, the total quantity of work under each item is taken out in proper unit of measurement. The total cost per unit of item is analysed and worked out, then the total cost for the item is found by multiplying the cost per unit quantity by number of units

### 2) Total Quantity Method

In Total Quantity Method item of work is divided into following five subdivisions:-

- a) Material → cost of Material + Transportation cost
- b) Labour
- c) Tools & Plants
- d) Overhead → 21% ± 5% of Total cost
- e) Profit



The total quantity of each subdivisions are found and multiplied by their individual unit cost.

Similarly, the cost of plants, overhead expenses and profit are determined. The cost of all the five-subheads is added to give the estimated cost of the item of work.

## # Data required for preparation of detailed estimate:-

### 1) Drawing:-

A detailed drawing showing plan, elevation and section with all the dimension is essential.

### 2) Specifications:-

Specification gives description of materials to be used, mode of execution, quality of work etc. The rates of items depend on specification.

### 3) Rates:-

The market rates of various items, wages of different categories of labour, cost of different materials should be made available.

### 3) Schedule of Rates (SOR):-

- For the estimation purpose, the Government P.W.D. publishes a booklet called Schedule of Rates.
- The rates may be obtained from this booklet or for some items rate may be worked out by rate analysis.

4) Mode of Measurement:- All work measure by in units. Because payment of labour depend on measurement units.

## # Factors to be Considered During preparation of

### Detailed estimate :-

#### 1) Availability of Local Labour:-

Daily wages of skilled local labour should be considered in preparation of detailed estimate. If skilled local labour is not available then it is to be brought from outside and their charges are to be considered accordingly in detailed estimate.

#### 2) Availability of Materials:-

If the materials required for certain items are not easily available from the market, the rates of these items will be higher.

#### 3) Location of site:-

This is an important factor. One has to consider transportation charges, loss of materials, damage of materials, etc. If site is located far away from developed area.

#### 4) Transportation of Materials:-

The cost of transportation of materials is also to be considered in detailed estimate. The transportation cost of the materials of small quantities to a considerable distance is higher than the transportation cost of the materials of large quantities.

#### 5) Quantity of Material:-

For a large construction project, a large quantity of materials is required and it can be purchased at lower rate. So the rate of material is to be considered according to the volume of work.



# # Checklist of items of work in load bearing structure:-

S.N.	Item of Work
1.	Excavation for foundation
2.	Soling below footing
3.	P.C.C below footing
4.	Stone Masonry Work in sub structure for foundation upto plinth.
5.	Backfilling for plinth
6.	Soling below flooring P.C.C.
7.	P.C.C. below flooring
8.	D.P.C. above stone masonry
9.	Brick Masonry in Super structure
10.	Fixing of door and window frames
11.	R.C.C. Work for lintel and chajja
12.	R.C.C. Work for floor beam and slab
13.	External Plastering
14.	Internal Plastering
15.	Flooring Work
16.	Fixing of Door
17.	<del>electrification</del> Fixing of window
18.	electrification
19.	Plumbing
20.	Painting

## # Checklist of Items of Work in R.C.C. Structure:-

S.N.	Item of Work
1)	Excavation for foundation
2)	Soling below footing
3)	P.C.C. Below footing
4)	R.C.C Work for foundation
5)	R.C.C Work for column upto Ground level
6)	R.C.C Work for Ground Beam
7)	Brick Masonry for plinth
8)	Casting of column upto plinth
9)	Backfilling for plinth
10)	Soling below flooring P.C.C
11)	P.C.C below flooring
12)	D.P.C above stone masonry
13)	R.C.C Work for column up to lintel level.
14)	R.C.C Work for chajja, left etc.
15)	R.C.C Work for column upto slab level.
16)	R.C.C Work for floor beam and slab
17)	Brick masonry in super structure.
18)	fixing of door and window frames
19)	External plastering
20)	Internal plastering
21)	Flooring work
22)	fixing of door
23)	fixing of window
24)	electrification
25)	Plumbing
26)	Painting



## Sequence of execution of work (Load Bearing Structure) :-

- 1) Excavation for foundation
- 2) Soling below PCC for foundation
- 3) P.C.C below foundation
- 4) U.C.R. masonry for foundation (substructure) [UCR → uncoursed Random]
- 5) Earthwork in Backfilling for plinth
- 6) Soling below P.C.C. flooring
- 7) P.C.C below flooring
- 8) D.P.C. 10cm Thickness
- 9) Brick masonry
- 10) Door frame
- 11) lintel 0.1m thick
- 12) Beam & slab
- 13) Reinforcement steel work
- 14) Internal plaster
- 15) External plaster
- 16) Flooring
- 17) Door panel
- 18) White washing
- 19) Painting

## BAR BENDING SCHEDULE (BBS)

Definition:- Bar Bending is the process of cutting & Bending of reinforcement bar into required shape.

and making it's list which describes.

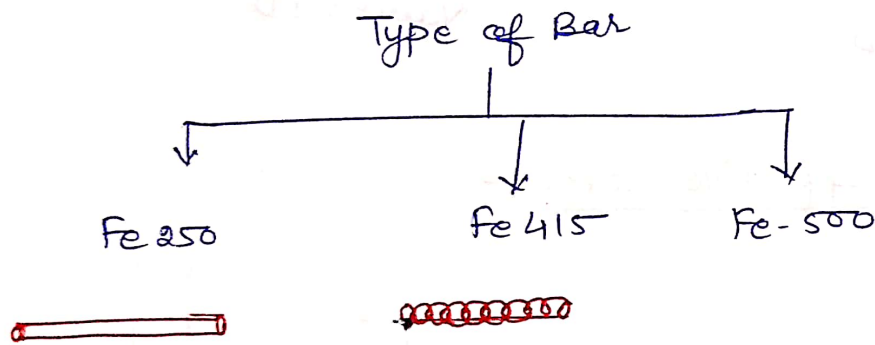
- i) Location & Marking of bar
- ii) Type of Bar
- iii) size of Bar
- iv) cutting length of Bar
- v) Number of Bar
- vi) Bending Details of Bar
- vii) Total Quantity

of each bar in a reinforcement drawing of a structure. This process of listing is called scheduling.

## Advantage of Bar Bending Schedule :-

- 1) cutting length & Bending of reinforcement can be done.
- 2) B.B.S. avoids wastage of steel reinforcement & thus saves project cost.
- 3) It provides better estimation of Reinforcement steel reinforcement for each & every structure members.
- 4) B.B.S is very much useful during auditing of Reinforcement & provides check or Theft & pilferage.
- 5) It enables easy and fast preparation of Bills of Construction work for clients & Contractors.

## Types of Reinforcement Bar :-



## Size & Unit Weight of Bar :-

<u>Dia. of Bar</u>	<u>Unit Weight of Bar (<math>D^2/162</math>)</u>
6 mm	0.222 Kg/m
8 mm	0.395 Kg/m
10 mm	0.617 Kg/m
12 mm	0.889 Kg/m
16 mm	1.580 Kg/m
20 mm	2.470 Kg/m
22 mm	2.987 Kg/m
25 mm	3.858 Kg/m
32 mm	6.320 Kg/m

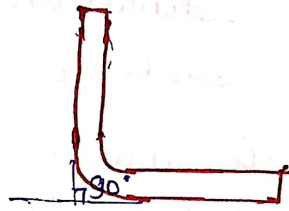


• Bend Deduction & Values :-

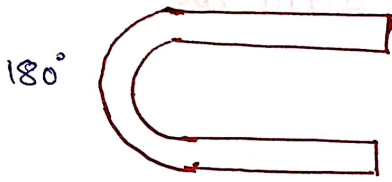
Bend increases the length of Bar. So we need lesser length than we see in drawing. So cutting length is taken lesser than the required length.



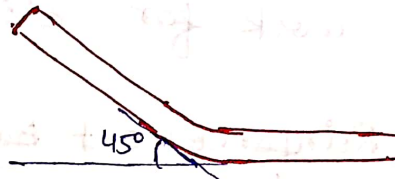
Value =  $3D$



Value =  $2D$

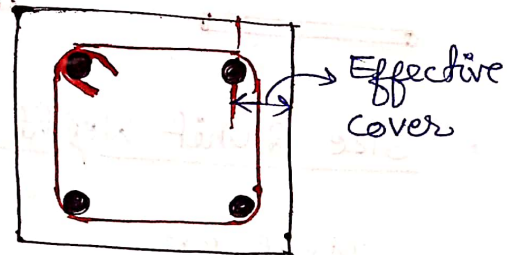
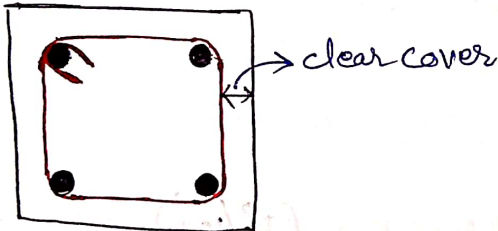


Value =  $4D$



Value =  $1D$

• Clear Cover & Effective Cover :-



Value of clear cover :-

- Footing → 50mm
- Column → 40mm
- Beam → 25mm
- slab → 20mm
- staircase → 15mm
- Chajja → 15mm
- Pile → 60mm
- Pile Cap → 60mm

## Standard codes used for BBS :-

- IS 456-2000 Plain & Reinforced concrete
- IS 2502-1963 code of practice for Bending & fixing
- IS 5525-1969 Detailing of Reinforcement in RCC Work
- SP 34-1987 concrete Reinforcement Detailing  
(special publication)

## Symbols & Representation in BBS :-





<u>Symbol</u>	<u>Representation</u>
	Plain Round Bar
	Plain square bar
	Deformed bar
	centre to centre spacing

Diagram showing a triangle with arrows pointing to the symbols for Plain Round Bar, Plain square bar, and Deformed bar, with the label "dia of bar" next to it.

## # Percentage of reinforcement for various structural Members

Lintel, slab = 0.7% to 1%

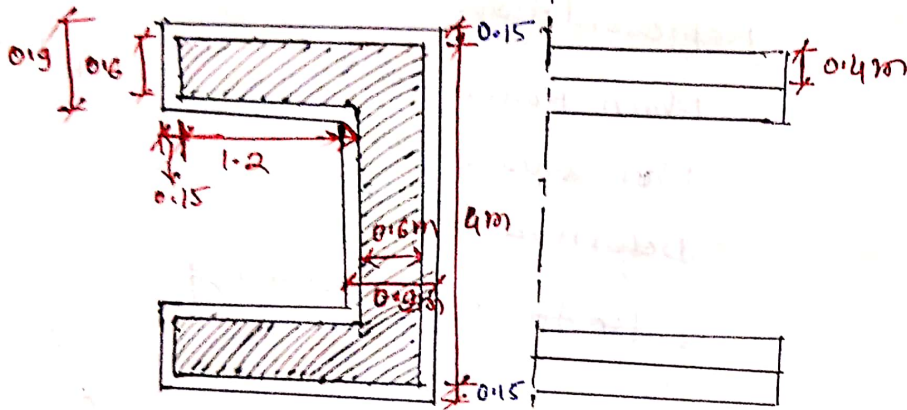
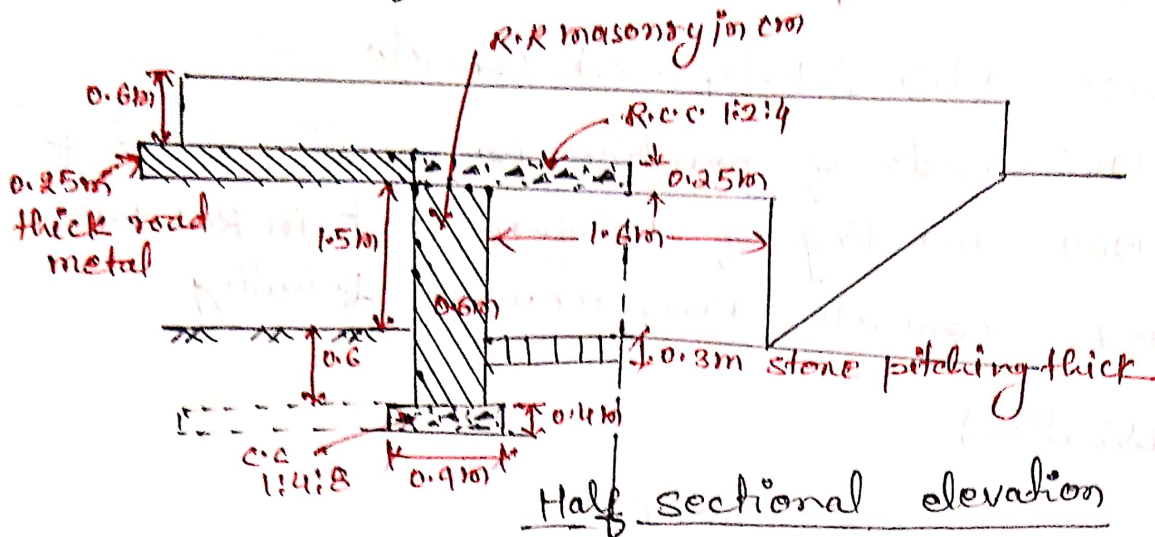
Beam = 1% to 2%

Column = 1% to 6% (4% Recommended)

Foundation = 0.5% to 2%



# Detailed estimate of SLAB CULVERT



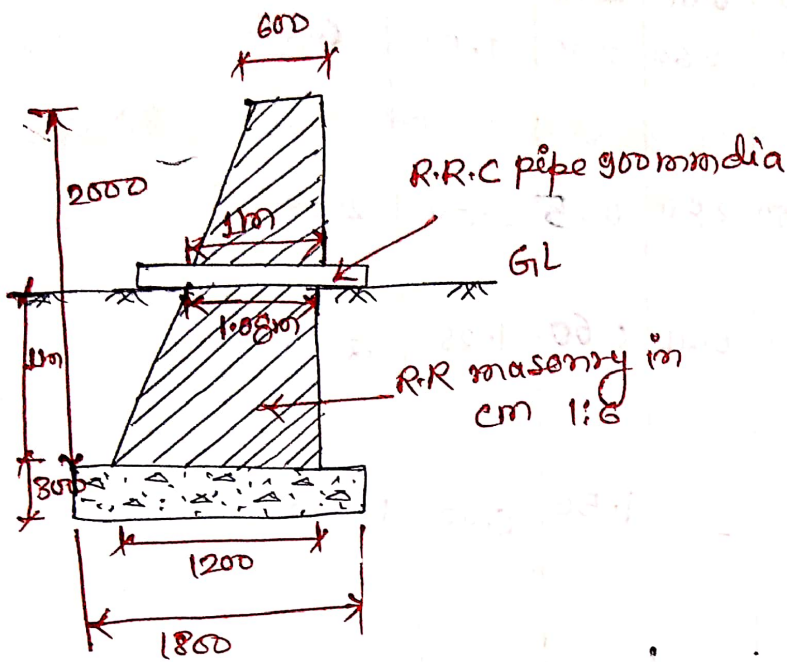
## Detailed estimate of a slab culvert

S.N.	Description of Items	Nos	L	B	H/D	Qty	Total Qty.
1)	Earthwork excavation for foundation						
	• for Abutments	2	4.30	0.90	1.00	3.87	7.74
	• for Return (wing) Wall	4	1.35	0.90	1.00	<del>1.08</del> 1.21	<del>4.32</del> 4.84
2)	cc(1:4:8) for foundation Bed						
	• for Abutments	2	4.30	0.90	0.40	1.55	3.10
	• for Return Walls	4	1.35	0.90	0.40	0.48	1.92

3)	R.R masonry in cm (1:3)						
	• for Abutments	2	4.50	0.60	2.10	5.04	10.08
	• for Return Walls	4	1.20	0.60	2.10	1.51	6.05
4)	R.C.C (1:2:4) for Deck Slab	1	4.00	2.80	0.25	2.80	2.80
5)	R.C.C (1:2:4) for parapet Walls	2	5.20	0.40	0.60	1.25	2.50
6)	Plastering for Abutments inside vent	2	4.50	-	1.50	6.00	12.00
7)	Plastering for parapet wall in cm (1:4) - m <sup>2</sup>						
	• outside & inside	4	5.20	-	0.60	3.12	12.48
	• Top of Parapet	2	5.20	-	0.40	2.08	4.16
	• Ends of Parapet	4	-	0.40	0.60	0.24	0.96
8)	Dry stone pitching inside vent	1	4.60	1.60	0.30	1.92	1.92



# Estimate of Pipe Culvert



Note:- Take the length of Head Wall = 5m

Detailed estimate of a pipe culvert :-

S.N.	Description of Items	Nos	L	B	H/D	Qty.	Total Qty	Explanatory Notes
1)	Earthwork excavation for pipe culvert	1	5	1.8	1.30	11.70	11.70	
2)	Plain cement Concrete	1	5	1.8	0.30	2.70	2.70	
3)	R.R masonry in CM (1:6)	1	5	0.9	2.00	9.00	9.00	$B = \frac{0.6 + 1.2}{2} = 0.9$
	Deduction of pipe	1	$\left[ \frac{(A)}{4} \times (0.9)^2 \right] \times$		$(L)$ 1.04	0.66	-0.66	$= \frac{1 + 1.08}{2} = 1.04$
						Total =	8.34 cum	

# UNIT-4

## Mode of Measurements

⇒ The units of measurement of various items of work are based upon their size, shape & nature of general principles to be followed for mode of measurement

- 1) Volume Work :- Where length, width, Height/depth can be measured easily is calculated in cu.m ( $m^3$ ) [i.e,  $L \times B \times H$ ]  
Exa:- Excavation for foundation etc.
- 2) The shallow or thin work whose depth or thickness can not be measure accurately. They calculated in sq.m ( $m^2$ ) [i.e,  $L \times B$  or  $L \times H$ ]  
Eg:- Plastering & Flooring, painting.
- 3) Work having long length, small thickness shall be measured running meter (i.e,  $L$ )  
e.g:- Water supply pipe & road
- 4) Steel work is measured in terms of its weight.  
(i.e, Total Volume of steel ( $m^3$ )  $\times$  Weight density of steel ( $kg/m^3$ )  
# Density of steel =  $7850 \text{ kg/m}^3$
- 5) Certain items such as wash basin, w.c. sheet seat, kitchen sink are measured in numbers (Nos.)



## # Rules of deductions for openings as per IS 1200 for Brickwork

- Brickwork shall generally be measured in cubic metres, unless otherwise stated
- Walls one brick thick and less shall each be measured separately in square metres stating thickness.

⇒ A/c to IS 1200 No deductions or additions shall be made on any account for the following:

- a) Ends of dissimilar materials (that is joists, beams, lintel, posts, girders, rafters, purlins, trusses, corbels, steps etc.) upto  $0.1 \text{ m}^2$  in section.
- b) opening up to  $0.1 \text{ m}^2$  in area (explain in note)
- c) Wall plates, bed places, and bearing of slabs, chajjas and the like, where thickness does not exceed 10cm and bearing does not extend over the full thickness of wall.
- d) Cement concrete blocks as for hold fasts and holding down bolts.
- e) Iron fixtures, such as wall ties, pipes upto 300mm diameter and hold fasts for doors and windows.
- f) chases of section not exceeding 50cm in girth.

Note:- In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded and extra width of rebated reveals, if any shall also be excluded.



## Rules of deduction as per IS 1200 for Plastering

- For jambs, soffits, sills, etc. for opening not exceeding  $0.5\text{m}^2$  each in area, for ends of joists, beams, posts, girders, steps, etc. not exceeding  $0.5\text{m}^2$  each in area and for opening exceeding  $0.5\text{m}^2$  and not exceeding  $3\text{m}^2$  in each area, deductions and addition shall be made in the following manner:

a) No deduction shall be made for ends of joists, beams, posts etc. and opening not exceeding  $0.5\text{m}^2$  each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings nor for finish to plaster around ends of joists, beams, posts etc.

b) Deduction for openings exceeding  $0.5\text{m}^2$  but not exceeding  $3\text{m}^2$  each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc of these openings.

i) When both faces of wall are plastered with same plaster, deduction shall be made for one face only.

ii) When two faces of wall are plastered with different types of plaster or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side on which width of reveals is less than that on the other side but no deduction shall be made on the other side; where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from areas of plaster or pointing as the case may be.

iii) When only one face is plastered and the other face is not, full deduction shall be made from plaster if width of reveal on plastered side is less than that on unplastered side but if width of reveal on both sides are equal or width of



reveal on plastered side is more, no deduction shall be made.

iv) When width of door frame is equal to thickness of wall or is projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

c) In case of opening of area above  $3\text{sq.m}$  each, deduction shall be made for opening on each face but jambs, soffit and sills shall be measured.

Note:- Rules of deduction as per IS 1200 for painting is same as plastering.

**THE UNITS OF MEASUREMENTS AND PAYMENTS FOR VARIOUS  
ITEMS OF WORKS AND MATERIALS**

Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
	<b>Earthwork —</b>			
1.	Earthwork in excavation in ordinary soil, earthwork in mixed soil with kankar, bajri, etc. earthwork in hard soil ...	cu m	per % cu m	% cu ft
2.	Rock excavation ...	cu m	per % cu m	% cu ft
3.	Earthfilling in excavation in foundation ...	cu m	per % cu m	% cu ft
4.	Earthfilling in foundation trenches ... (Usually not measured and not paid separately)	cu m	per % cu m	% cu ft
5.	Earthfilling in plinth ...	cu m	per % cu m	% cu ft
6.	Earthwork in banking, cutting, in road and irrigation channel ...	cu m	per % cu m	% cu ft
7.	Surface dressing and levelling, cleaning, etc. ...	sq m	per sq m	% sq ft
8.	Cutting of trees (Girth specified) ...	no.	per no.	per no
9.	Puddling, Puddle clay core ...	cu m	per % cu m	% cu ft
10.	Sand filling ...	cu m	per cu m	% cu ft
11.	Quarrying of stone or boulder ...	cu m	per cu m	% cu ft
12.	Blasting of rock (Blasted stone stacked and then measured) ...	cu m	per cu m	% cu ft
	<b>Note.</b> — (For earthwork, normal lead is 30 m and normal lift is 1.5 m).			



Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
<b>Concrete —</b>				
1.	Lime concrete (L.C.) in foundation ...	cu m	per cu m	% cu ft
2.	Lime concrete (L.C.) in roof terracing, thickness specified ... (May also be in volume basis as practice in U.P.).	sq m	per sq m	% sq ft
3.	Cement concrete (C.C.) ...	cu m	per cu m	per cu ft
4.	Reinforced cement concrete (R.C.C.) ...	cu m	per cu m	per cu ft
5.	C.C. or R.C.C. Chujja, sun shade ...	cu m	per cu m	per cu ft
6.	Precast C.C. or R.C.C. ...	cu m	per cu m	per cu ft
7.	Jali work or jaffri work or C.C. tracery panels (Thickness specified) ...	sq m	per sq m	per sq ft
8.	Cement concrete bed ...	cu m	per cu m	per cu ft
<b>D.P.C. —</b>				
9.	Damp proof course — Cement concrete, Rich cement mortar, Asphalt, etc. (Thickness specified) ...	sq m	per sq m	% sq ft
<b>Brickwork —</b>				
1.	Brickwork in foundation and plinth, in super-structure, in arches, etc., in cement, lime or mud mortar ...	cu m	per cu m	% cu ft
2.	Sun dried brickwork ...	cu m	per cu m	% cu ft
3.	Honey-comb brickwork, thickness specified... (May also be in volume basis as practice in U.P.)	sq. m	per sq m	% sq ft
4.	Brickwork in jack arches, if measured separately ...	cu m	per cu m	% cu ft
5.	Jack arch roofing including top finishing ...	sq m	per sq m	% sq ft
6.	Brickwork in well steining ...	cu m	per cu m	% cu ft
7.	Half-brickwork with or without reinforcement (May also be in cu m as practice in U.P.)	sq m	per sq m	% sq ft
8.	Thin partition wall ...	sq m	per sq m	% sq ft
9.	Reinforced brickwork (R.B. work) ...	cu m	per cu m	% cu ft
10.	String course, drip course, weather course, coping etc. (Projection specified) ...	metre	per m	per r ft

Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
11.	Cornice (Projection and type specified) ...	metre	per m	per r ft
12.	Brickwork in Fire place, Chulla, Chimney ...	cu m	per cu m	% cu ft
13.	Pargetting Chimney, fire place flue ...	metre	per m	per r ft
14.	Brick edging (by road side) ...	metre	per m	per r ft
1.	<b>Stone work —</b> Stone masonry, Random Rubble masonry, Coursed Rubble masonry, Ashlar masonry in walls, in arches, etc. ...	cu m	per cu m	% cu ft
2.	Cut stone work in lintel, beam, etc. ...	cu m	per cu m	per cu ft
3.	Stone slab in roof, shelve, etc., stone chujias, stone sun shed, etc. (Thickness specified) ...	sq m	per sq m	% sq ft
4.	Stone work in wall facing or lining (Thickness specified)	sq m	per sq m	per sq ft
1.	<b>Wood work —</b> Wood work, door and window frame or chow-khat, rafters beams, roof trusses, etc. ...	cu m	per cu m	per cu ft
2.	Door and window shutters or leaves, panelled, battened, glazed, part panelled and part glazed, wire gauged, etc. (Thickness specified) ...	sq m	per sq m	per sq ft
3.	Door and window fittings as hinges tower bolts, sliding bolts, handles, etc. ... (May also be on the basis of area of shutters as practice in U.P.)	no.	per no.	per no.
4.	Timbering, boarding (Thickness specified) ...	sq m	per sq m	per sq ft
5.)	Timbering of trenches (Area of face supported) ...	sq m	per sq m	per sq ft
6.	Sawing of timber ...	sq m	per sq m	per sq ft
7.	Woodwork in partition, Ply wood, etc. ...	sq m	per sq m	per sq ft
8.	Ballies (Diameter specified) ...	sq m.	per sq m	per sq ft
	<b>Steel work —</b>	metre	per m	per r ft
1.	Rolled Steel joists, Channels, Angles, T-irons, Flats, Squares, Rounds, etc. ...	quintal	per q	per cwt
2.	Steel reinforcement bars, etc., in R.C.C., R. B. work ...	quintal	per q	per cwt
3.	Bending, binding of steel reinforcement ...	quintal	per q	per cwt



Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
4.	Fabrication and hoisting of steel work ...	quintal	per q	per cwt
5.	Expanded Metal (X.P.M.), size specified ...	sq m	per sq m	per sq ft
6.	Fabric reinforcement, wire netting ...	sq m	per sq m	per sq ft
7.	Iron work in struss ...	quintal	per q	per cwt
8.	Gusset plate (Minimum rectangular size from which cut) ...	quintal	per q	per cwt
9.	Cutting of Iron Joists, channels ...	cm	per cm	per inch
10.	Cutting, Angles, Tees, Plate ...	sq cm	per sq cm	per sq inch
11.	Threading in iron ...	cm	per cm	per inch
12.	Welding, solder of sheets, plates (Welding of rails, steel, trusses, rods— per no.) ...	cm	per cm	per inch
13.	Boring holes in iron ...	no	per no.	per no.
14.	Cast Iron (C.I.) pipe, Dia. specified ...	metre	per m	per ft
15.	Rivets, Bolts and nuts, Anchor bolts, Lewis bolts, Holding down bolts, etc. ...	quintal	per q	per cwt
16.	Barbed wire fencing ...	metre	per m	% r ft
17.	Iron gate (May also be by weight, quintal) ...	sq m	per sq m	per sq ft
18.	Iron hold fast (May also be by no.) ...	quintal	per q	per cwt
19.	Iron railing (Height and types specified) ...	metre	per m	per r ft
20.	Iron grill, collapsible gate (May also be by weight, quintal) ...	sq m	per sq m	per sq ft
21.	Rolling shutter ...	sq m	per sq m	per sq ft
22.	Steel doors and windows (type and fixing specified) ...	sq m	per sq m	per sq ft
<b>Roofing —</b>				
1.	Tiled roof — Allahabad tile, Faizabad tile, Mangalore tile, etc. including battens ...	sq m	per sq m	% sq ft
2.	Country tile roof including bamboo jaffri ...	sq m	per sq m	% sq ft
3.	Corrugated iron (G.C.I.) roof, Asbestos cement (A.C.) sheet roof ...	sq m	per sq m	% sq ft

Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS	Sl. No.
4.	Slate roofing, timber roofing ...	sq m	per sq m	% sq ft	9.
5.	Thatch roofing including bamboo jaffri (Thickness specified) ...	sq m	per sq m	% sq ft	10.
6.	Eave board (Thickness specified) ...	sq m	per sq m	per sq ft	11.
7.	R.C.C., R.B. slab roof (excluding steel) ...	cu m	per cu m	per cu ft	12.
8.	Lime concrete roof over and inclusive of tiles or brick, or stone slab, etc. (Thickness specified) ...	sq m	per sq m	% sq ft	13.
9.	Mud roof over and inclusive of tiles, or bricks, or stone slab, etc. (Thickness and type specified) ...	sq m	per sq m	% sq ft	14.
10.	Ridges, valleys, gutters, (Girth specified) ...	metre	per m	per r ft	15.
11.	Tar felting, Bituminous painting ...	sq m	per sq m	% sq ft	1.
12.	Insulating layer in roof of sand and clay, asphalt, etc. ...	sq m	per sq m	% sq ft	2.
13.	Expansion, contraction or construction joint ...	metre	per m	per r ft	3.
14.	Ceiling— Timber, A.C. Sheet plain, Cloth, Cement plaster on XPM, Paste board, etc. ...	sq m	per sq m	per sq ft	4.
15.	Centering and shuttering, Form work— Surface area of R.C.C. or R.B. work supported (May also be per cu m (cu ft) of R.C.C. or R.B. work)	sq m	per sq m	% sq ft	5.
<b>Plastering, Pointing and Finishing—</b>					
1.	Plastering— Cement mortar, Lime mortar, mud, etc. (Thickness, proportion specified)	sq m	per sq m	% sq ft	6.
2.	Pointing— Struck, Flush, Weather, etc. ...	sq m	per sq m	% sq ft	7.
3.	Dado (Thickness and type specified) ...	sq m	per sq m	% sq ft	8.
4.	Skirting (Thickness type and height specified)	metre	per m	per r ft	9.
5.	Cement mortar or lime mortar rubbing ...	sq m	per sq m	% sq ft	10.
6.	White washing, Colour washing, Cement washing (No. of coat specified) ...	sq m	per sq m	% sq ft	11.
7.	Distempering (No. of coat specified) ...	sq m	per sq m	% sq ft	12.
8.	Snow cement washing or finishing (No. of coat specified) ...	sq m	per sq m	% sq ft	13.



Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
9.	Painting, Varnishing (No. of coat specified)...	sq m	per sq m	% sq ft
10.	Polishing of wood work (No. of coat specified)	sq m	per sq m	% sq ft
11.	Painting letters and figures (Height specified)	no.	per no.	per no.
12.	Oiling and clearing of doors and windows ...	sq m	per sq m	% sq ft
13.	Coal tarring (No. of coat specified) ...	sq m	per sq m	% sq ft
14.	Removing of paint or varnish ...	sq m	per sq m	% sq ft
15.	Gobri Lepping (cow dung wash) ...	sq m	per sq m	% sq ft
<b>Flooring —</b>				
1.	2.5 cm (1") C.C. over 7.5 cm (3") L.C. Floor (including L.C.) ...	sq m	per sq m	% sq ft
2.	Conglomerate floor, artificial patent stone floor 2.5 cm (1") C.C. over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	% sq ft
3.	4 cm (1½") thick stone floor flag stone floor over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	% sq ft
4.	2.5 cm (1") marble flooring over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	per sq ft
5.	Mosaic or terrazo or granolithic floor over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	per sq ft
6.	Brick flat floor over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	% sq ft
7.	Brick on edge floor over 7.5 cm (3") L.C. (including L.C.) ...	sq m	per sq m	% sq ft
8.	2.5 cm (1") or 4 cm (1½") C.C., floor ...	sq m	per sq m	% sq ft
9.	Mud flooring finished gobri lepping ...	sq m	per sq m	% sq ft
10.	Apron or Plinth protection (May be of C.C., L.C., brick, etc.) ...	sq m	per sq m	% sq ft
11.	Door and window sill (C.C. or cement mortar plastered) ...	sq m	per sq m	% sq ft
<b>Miscellaneous Items —</b>				
1.	Ornamental cornice (Projection, type specified) ...	metre	per m	per r ft
2.	Moulding String course, Drip course, Beading, Throating, etc. ...	metre	per m	per r ft

Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS	
3.	Ornamental Pillar caps, Pillar base, Flowers, Brackets, etc. ...	no.	per no.	per no.	24.
4.	Railing (Height and type specified) ...	metre	per m	per r ft	25.
5.	Surface drain small (size, material, etc. specified) ...	metre	per m	per r ft	26.
6.	Surface drain large (item wise) — (i) Masonry ... (ii) Plastering ...	cu m sq m	per cu m per sq m	} $\frac{\%}{100}$ cu ft $\frac{\%}{100}$ sq ft	27.
7.	Pipe — rainwater, sanitary, water pipe, etc. (Dia. specified) ...	metre	per m		per r ft
8.	Laying pipe line — sanitary, water pipe, etc. (Dia, depth, bedding etc. specified) ...	metre	per m	per r ft	29.
9.	Jungle clearance (May also be per km for road and irrigation channel) ...	sq m or hectare	per sq m or per hectare	$\frac{\%}{100}$ sq ft or per acre	30.
10.	Silt clearance in irrigation channels (Similar to earthwork) (For thin layer upto 5 cm may be on area basis) ...	cu m	per $\frac{\%}{100}$ cu m	$\frac{\%}{100}$ cu ft	31.
11.	Trestle, Crate (size, type, etc. specified) ...	no.	per no.	per no.	32.
12.	Cleaning flues ...	no.	per no.	per no.	33.
13.	Cotton cords in sky light (May also be by weight in kg) ...	no.	per no.	per no.	34.
14.	Easing doors and windows ...	no.	per no.	per no.	35.
15.	Fixing doors and windows ...	no.	per no.	per no.	36.
16.	Supply and fixing of Hinges, Tower bolts, Hasp and staples, Handles, Hardwares, etc. ...	no.	per no.	per no.	37.
17.	Glazing ...	sq m	per sq m	per sq ft.	1.
18.	Glass panes (supply) ...	sq m	per sq m	per sq ft.	2.
19.	Fixing of glass panes or cleaning ...	no.	per no.	per no.	3.
20.	Renewing of glass panes ...	no.	per no.	per no.	4.
21.	Well sinking (Masonry or tube well) ...	metre	per m	per r ft.	5.
22.	Pile driving or sinking ...	metre	per m	per r ft.	
23.	Furnitures — Chairs, tables, etc. (size shape specified) ...	no.	per no.	per no.	



Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
24.	Painting furnitures ...	no.	per no.	per no
25.	Caning chairs ...	no.	per no.	per no.
26.	Pitching of brick, stone, kankar, etc. ... (Brick pitching may also be on area basis in sq m)	cu m	per cu m	% cu ft
27.	Lining of Irrigation Channel, Tunnel, etc. ... Materials, thickness specified ... (Thick lining may be in volume basis in cu m)	sq m	per sq m	% sq ft
28.	Kankar quarrying, kankar supply ...	cu m	per cu m	% cu ft
29.	Kankar consolidation, road metal consolidation ...	cu m	per cu m	% cu ft
30.	Dag-belling ... (May also be per km)	metre	per m	% r ft
31.	Bituminous road surfacing ...	sq m	per sq m	% sq ft
32.	Dismantling —	Same as for different items	Same as for different items	Same as for different items
33.	Dismantling of brick masonry ...	cu m	per cu m	% cu ft
34.	Grouting (Bituminous grouting of road metal, cement grouting of concrete) ...	sq m	per sq m	% sq ft
35.	Grouting of cracks, joints, etc. ...	metre	per m	per r ft
36.	Electric Wiring or Electrification Light, Fan, Plug points ...	point	per point	per point
37.	Watercloset (W.C.), Wash hand basin, Man-hole, etc. (size specified) ...	no	per no	per no
<b>Materials —</b>				
1.	Supply of bricks ...	% nos.	per % nos.	% nos.
2.	Supply of Sand, Surkhi, Cinder, etc. ...	cu m	per cu m	% cu ft
3.	Supply of cement ...	bag of 50 kg	per bag or per quintal or per tonne	per cwt or per ton
4.	Supply of lime unslaked ...	quintal	per quintal	per maund
5.	Supply of lime slaked ... (May also be in volume basis in cu m)	quintal	per quintal	per maund

Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
6.	Supply of Brick ballast, Stone ballast, Aggregate, etc. ...	cu m	per cu m	% cu ft
7.	Broken bricks, Kankar, etc. ...	cu m	per cu m	% cu ft
8.	Supply of Timber ...	cu m	per cu m	% cu ft
9.	Supply of Steel ...	quintal	per q or per tonne	per cwt
10.	Supply of Bitumen, Tar ...	tonne	per tonne	per ton
11.	Supply of Coal ...	tonne	per tonne	per ton
12.	Supply of A.C. sheets (Measured flat) ...	sq m	sq m	sq ft
13.	Supply of G.I. sheet ...	quintal	per quintal	per cwt
14.	Supply of switches, plugs, ceiling roses, bulbs, brackets, etc. ...	no.	per no.	per no.
15.	Supply of insulated electric wire (size specified) ...	quintal	per quintal	per cwt.
16.	Supply of bare electric wire (size specified) ...	quintal	per quintal	per cwt.
17.	Tents, sholdaries (size specified) ...	no.	per no.	per no.
18.	Supply of Water closet, W.C. (size specified) ...	no.	per no.	per no.
19.	Supply of Wash hand basin (size specified) ...	no.	per no.	per no.
20.	Supply of Cowl, Mica valve, Intercepting trap, etc. (size specified) ...	no.	per no.	per no.
21.	Supply of Bib cock, Stop cock, Ball cock, etc. (size specified) ...	no.	per no.	per no.
22.	Supply of Ferrule, C.I. Tank, Water meter, etc. (size specified) ...	no.	per no.	per no.
23.	Supply of pipe, C.I. pipe, S. W. pipe. Hume pipe, A.C. pipe, G.I. pipe, etc. (Dia. specified) ...	metre	per m	per r ft
24.	Supply of lead, lead wool ...	kg or quintal	per kg or per quintal	per cwt
25.	Spun yarn ...	kg	per kg	per lb
26.	Supply of varnish, oil, etc. ...	litre	per litre	per gl



Sl. No.	Particulars of Items	Units of measurement in MKS	Units of payment in MKS	Units of payment in FPS
27.	Supply of paint ready mix	...	litre	per litre
28.	Supply of stiff paint	...	kg	per kg
29.	Explosive for blasting	...	kg	per kg

**Note :** (i) Particulars of items should be fully described.  
 (ii) For further items of work P. W. D. Schedule of Rates may be consulted. (See Chapter 20).  
 (iii) For Rules and Methods of Measurement. (See Chapter 14).

**SIZES AND DIMENSIONS OF VARIOUS WORKS IN MKS AND THE CORRESPONDING FPS UNITS, APPROXIMATE**

- |   |  |
|---|--|
| <p>1. Sizes of Doors —</p> <p>120 cm × 210 cm } — 4' — 0" × 6' — 6½"</p> <p>(1.20 m × 2.10 m)</p> <p>110 cm × 200 cm } — 3' — 6" × 6' — 6"</p> <p>(1.10 m × 2.00 m)</p> <p>100 cm × 190 cm } — 3' — 3" × 6' — 3"</p> <p>(1.00 m × 1.90 m)</p> <p>90 cm × 180 cm } — 3' — 0" × 6' — 0"</p> <p>(0.90 m × 1.80 m)</p> <p>75 cm × 180 cm } — 2' — 6" × 6' — 0"</p> <p>(0.75 m × 1.80 m)</p> | <p>5. Thickness of Doors and Windows, Shutter or Leaves</p> <p>2.5 cm — 1"                  3 cm — 1¼"</p> <p>4 cm — 1½"                  4.5 cm — 1¾"</p>   |
| <p>2. Size of Windows —</p> <p>100 cm × 150 cm } — 3' — 3" × 5' — 0"</p> <p>(1.00 m × 1.50 m)</p> <p>90 cm × 120 cm } — 3' × 4'</p> <p>(0.90 m × 1.20 m)</p>  | <p>6. Thickness of Lime Concrete in Foundation —</p> <p>15 cm — 6"                  20 cm — 8"</p> <p>25 cm — 10"                  30 cm — 12"</p> <p>40 cm — 16"                  45 cm — 18"</p> |
| <p>3. Size of C.S. Windows, Ventilators —</p> <p>120 cm × 60 cm } — 4' × 2'</p> <p>(1.20 m × 0.60 m)</p> <p>100 cm × 60 cm } — 3' — 3" × 2'</p> <p>(1.00 m × 0.60 m)</p> <p>90 cm × 50 cm } — 3' — 0" × 1' — 6"</p> <p>(0.90 m × 0.50 m)</p>  | <p>7. Thickness of Lime Concrete in Roof Terracing —</p> <p>7.5 cm — 3"</p> <p>10 cm — 4"</p> <p>12 cm — 4½"</p>   |
| <p>4. Size of Chowkhat sections for Doors and Windows —</p> <p>12 cm × 7.5 cm — 5" × 3"</p> <p>10 cm × 10 cm — 4" × 4"</p> <p>10 cm × 7.5 cm — 4" × 3"</p> <p>7.5 cm × 7.5 cm — 3" × 3"</p>   | <p>8. Thickness of R.C.C. Slab —</p> <p>7.5 cm — 3"                  10 cm — 4"</p> <p>12.5 cm — 5"                  15 cm — 6"</p>  |
|   | <p>9. Thickness of Plastering —</p> <p>10 mm — ¾"                  12 mm — ½"</p> <p>15 mm — ⅝"                  20 mm — ¾"</p>  |
|   | <p>10. Thickness of D.P.C. —</p> <p>2 cm — ¾"</p> <p>2.5 cm — 1"</p> <p>4 cm — 1½"</p>   |

## 11. Thickness of C.C. Floor —

- 2 cm —  $\frac{3}{4}$ "  
 2.5 cm — 1"  
 4 cm —  $1\frac{1}{2}$ "  
 2.5 cm C.C. floor } — 1" C.C. floor  
 over 7.5 cm L.C. } over 3" L.C.

## 12. Insulation layer in Roof —

- 2.5 cm — 1"  
 4 cm —  $1\frac{1}{2}$ "

## 13. Steps, Rise and Tread —

- 15 cm × 30 cm — 6" × 12"  
 15 cm × 28 cm — 6" × 11"  
 18 cm × 28 cm — 7" × 11"

## 14. Height of Plinth —

- 30 cm — 1' - 0"      45 cm — 1' - 6"  
 60 cm — 2' - 0"      75 cm — 2' - 6"

## 15. Height of Building —

- 2.80 m — 9' - 3"      3.00 m — 10' - 0"  
 3.30 m — 11' - 0"      3.60 m — 12' - 0"  
 3.90 m — 13' - 0"      4.20 m — 14' - 0"

## 16. Size of Rooms —

- 3 m × 3 m — 10' × 10'  
 3.00 m × 3.60 m — 10' × 12'  
 3.60 m × 3.60 m — 12' × 12'  
 3.60 m × 4.20 m — 12' × 14'  
 3.60 m × 4.80 m — 12' × 16'

**Mild steels bars, metric dimensions and weights —**

Dia. of bars fps. units currently used	$\frac{1}{4}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{5}{8}$ "	$\frac{3}{4}$ "	$\frac{7}{8}$ "	1"	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "
Dia. and weight in metric unit to be used Dia. ...	6 mm	10 mm	12 mm	16 mm	20 mm	22 mm	25 mm	32 mm	40 mm
Wt. per metre ...	0.22 kg.	0.62 kg.	0.89 kg.	1.58 kg.	2.47 kg.	2.98 kg.	3.85 kg.	6.31 kg.	9.86 kg.



## UNIT-5, Rate Analysis

Rate Analysis :- The determination of rate per unit of a particular item of work, from the cost of quantities of materials, the cost of labourers and other miscellaneous petty expenses require for its completion is known as the analysis of rate. Contractor profit 10% is also included in the rate analysis.

Purpose of Rate Analysis :-

- 1) To find the current rate per unit of an item at the locality.
- 2) To check feasibility of rates offered by contractors.
- 3) To calculate the cost of extra items not included but required necessary in project.
- 4) To decide or fixed up the labour contract rate.
- 5) To maintain economical use of materials and process in completion of particular work.

Data required for Rate Analysis :-

- 1) Quantity & cost of materials
- 2) No. of labour and rate of labours.
- 3) Cost of equipment or Tools & plants.
- 4) Contingencies, Water charges
- 5) overhead or establishment charges and Contractors profit.

Factor affecting the Rate Analysis :-

- 1) Quantity of materials and their cost.
- 2) Daily wages of labour with their respective outputs.
- 3) Specifications of works and materials, methods of construction, quality of materials, proportion of mortar & protection of work etc.



- 4) Water availability, different types of tool and plants, location of the site of work & its distance from the sources of materials & the cost of Transportation
- 5) The range of profit & overhead, miscellaneous expenses of Contractor.
- 6) Environmental & climatic conditions.

# The analysis of rates is worked out for the unit payment of the particular item of work under two heads:-

- 1) Material
- 2) Labour

$$\text{Material cost} + \text{Labour cost} = \text{Cost of Item of work}$$

# Other items included are:-

- Tools and Plants (T&P) = 2.5 to 3% of the labour cost
- Transportation cost more than 8 km is considered
- Water charges = 1.5 to 2% of total cost
- Contractor's profit = 10%

# Material Rate:-

Rate of Material is usually taken as the rates delivered at the site of work and include the first cost (cost at origin), cost of transport, railway freight if any taxes, etc. If the material are to be carried from a distant place, more than 8 kms (5 miles). Then cost of Transportation also added. The rate of material vary from place to place and



## # Labour Rate:-

The labour can be classified into the following:-

- skilled 1<sup>st</sup> class labour
- skilled 2<sup>nd</sup> class labour
- unskilled

⇒ The labour charges can be obtained from the standard schedule of rates.

⇒ 30% of the skilled labour provided in the data may be taken as 1<sup>st</sup> class, remaining 70% as II<sup>nd</sup> class.

⇒ The rate of labour vary from place to place.

## # Contractor's Profit:-

- ~~Adding 10% in the cost as Contractor's profit, when cost of carriage of cement and steel from the godown to the site of work should be allowed to the Contractor.~~
- If cement and steel are supplied by the department and the contractor is not to invest any money on these, then 10% profit is not allowed on cement and steel.
- If cement and steel are to be arranged by the contractor then 10% should be added as profit on these material.

## # Task OR Turnout-Turn Work

The capacity of doing work by an artisan or skilled labour in the form of quantity of work per day is known as the task-work or out-turn of the labour.

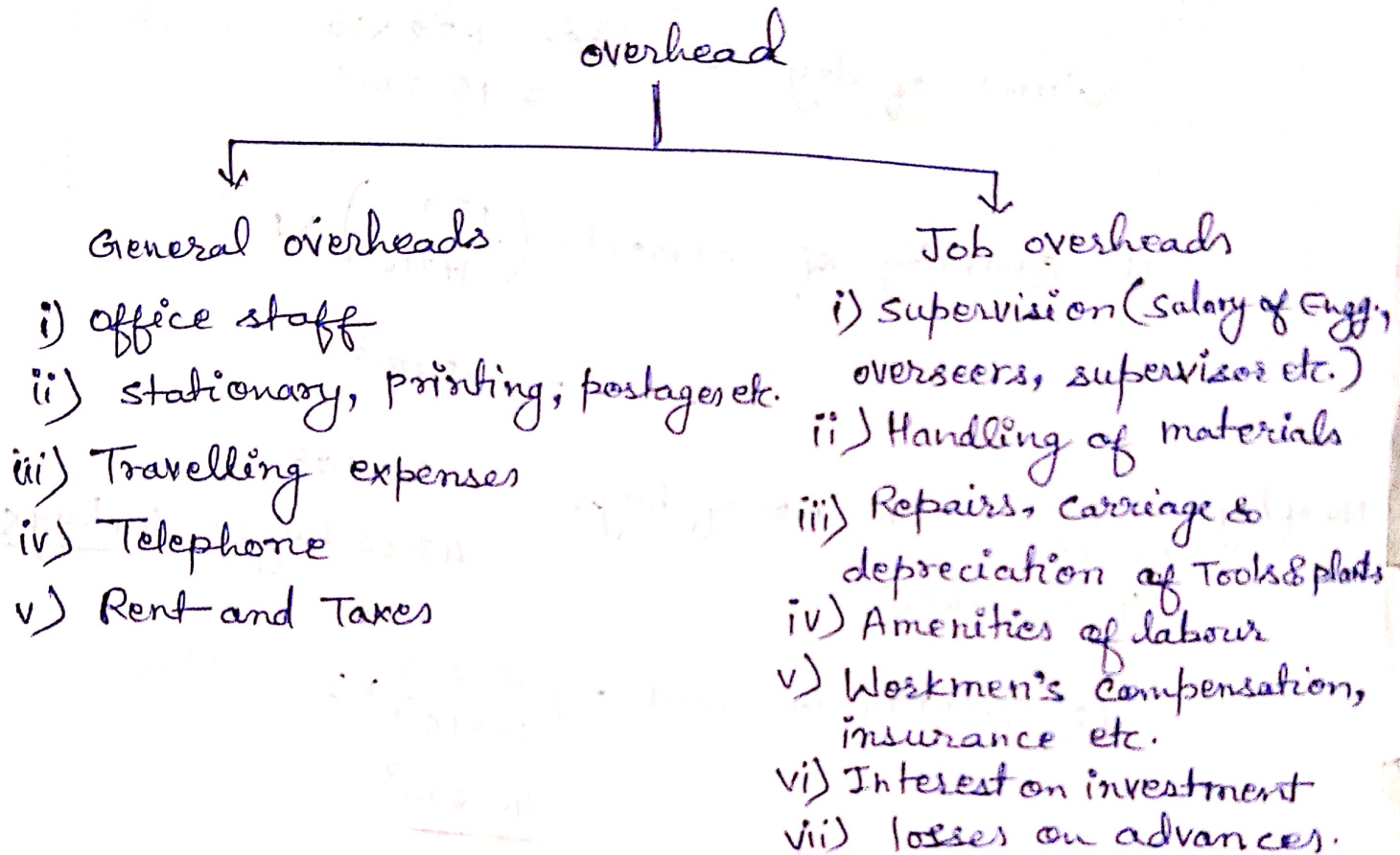
The out-turn of work per artisan varies to some extent according to the nature, size, height, situation, location etc. In bigger cities where specialised and experienced labour is available the outturn is greater than small towns. In well organised work less labour



required.

## # Overhead Cost :-

Overhead cost include general office expenses, rents, taxes, supervision and other costs which are indirect expenses and not productive expenses on the job.



Note:- A provision of 2.5% to 5% is made in the rate analysis as overhead charge. Expenses for small tools such as planks, ladders, ropes and other hand tools are also included in the overhead charges.

# Water charges :- For drinking purpose of the workers and for the work, arrangement of water is made sinking tube well, bore well or from temporary connection from municipality. For this purpose a provision of 1.5% to 2% of total cost (Material + labour + sundries) is made in the estimate.



# # Preparing rate Analysis for P.C.C Work :-

P.C.C Work (1:3:6) → M10

Volume →  $10\text{m}^3$

Add 52% extra for voids to get dry vol.<sup>m</sup> of concrete.

$$\text{Volume of dry concrete} = 1.52 \times 10 \\ = 15.2\text{m}^3$$

$$\textcircled{1} \text{ Quantity of cement} = \left( \frac{1.52}{1+3+6} \right) \times 1$$

$$= 1.52\text{m}^3$$

$$\text{No. of bags} = \frac{1.52}{0.0347}$$

$$= 43.8 \approx 44 \text{ bags}$$

$$\text{OR (No. of bags} = 1.52 \times 28.5$$

$$= 43.32 \text{ bags} \approx \underline{44 \text{ bags}}$$

$$\textcircled{2} \text{ Quantity of sand} = \left( \frac{1.52}{1+3+6} \right) \times 3$$

$$= \underline{4.56\text{m}^3}$$

$$\textcircled{3} \text{ Quantity of aggregate} = \left( \frac{1.52}{1+3+6} \right) \times 6$$

$$= \underline{9.12\text{m}^3}$$

Cost of material :-

S.N	Material	unit	Quantity	Rate	Amount (Rs.)
1.	Cement	Bags	44	350/-	15400/-
2.	Sand	$\text{m}^3$	4.56	1000/-	4560/-
3.	Aggregate	$\text{m}^3$	9.12	1200/-	10944/-

Total Amount = Rs. 30904/-



# Cost of labours

S.N	Labours	Men (Nos)	Rate	Per (day)	Amount
1)	skilled	$10 \times 4 = 40$	600	Per day	$\frac{24000}{6000}$ /-
2)	unskilled	$10 \times 4 = 40$	420	Per day	$\frac{4200}{16800}$ /-
				Total	$\frac{28200}{22800}$ /-

Total cost = cost of materials + cost of labour

$$= 30904 + 22800$$

$$= 53704 /-$$

Add 1.5% Water charges of total cost

$$= 53704 \times \left(\frac{1.5}{100}\right)$$

$$= 805.56 \approx 806 \text{ Rs./-}$$

Add 10% contractor's charges of total cost.

$$= 53704 \times \left(\frac{10}{100}\right)$$

$$= 5370.4 \approx 5371 \text{ Rs./-}$$

$$\text{Grand Total} = 53704 + 806 + 5371$$
$$= \text{Rs. } 59881 /-$$



# # Prepare Rate Analysis for a Brickwork :-

Given :- Cement mortar = 1:4

$$\text{Volume} = 10 \text{ m}^3$$

We know that No. of Bricks @ 500 per  $\text{m}^3$ ,

$$\begin{aligned} \text{No. of Brick} &= 500 \times 10 \\ &= 5000 \text{ Nos.} \end{aligned}$$

Volume of dry mortar = 30% of Volume

$$= \frac{30}{100} \times 10$$

$$= 3 \text{ m}^3$$

$$\text{① Quantity of Cement} = \frac{\text{Vol.}^m \text{ of dry mortar}}{\text{Cement mortar Ratio}} \times \text{Ratio of Cement}$$

$$= \frac{3}{1+4} \times 1$$

$$= 0.60 \text{ m}^3$$

$$\text{No. of bags} = 0.60 \times 28.5$$

$$= 17.10 \text{ bags} \approx 18 \text{ bags}$$

$$\text{② Quantity of Sand} = \frac{3}{1+4} \times 4$$

$$= 2.40 \text{ m}^3$$

### A) Cost of materials

S.N.	Material	Unit	Quantity	Rate	Amount (Rs.)
1)	Cement	Bags	18	350/-	6300/-
2)	Sand	m <sup>3</sup>	2.40	1000/-	2400/-
3)	Bricks	Nos.	5000	4/-	20,000/-

Total Amount = 28700/-

### B) Cost of labours

S.N.	Labour	Men (Nos.)	Rate	Per Day	Amount (Rs.)
1)	Head Mason	$\frac{1}{2}$	500	Per Day	250/-
2)	Mason	8	450	Per Day	3600/-
3)	Male Mazdoor	7	350	Per Day	2450/-
4)	Coolie/Woman Mazdoor	6	300	Per Day	1800/-
5)	Bhisti	2	250	Per Day	500/-
6)	T&P	Lumpsum	400	Lumpsum	400/-
7)	Scaffolding	Lumpsum	500	Lumpsum	500/-

Total Amount = 9750/-

$$\text{Total cost} = \text{Cost of Materials} + \text{Cost of labours}$$

$$= 28700 + 9750$$

$$\text{Total cost} = \text{Rs. } 38450/-$$

$$\text{Add } 1.5\% \text{ Water charges of total cost} = \frac{1.5}{100} \times 38450$$

$$\text{Water charges} = 576.75/-$$

$$\text{Add } 10\% \text{ Contractor's charges} = \frac{10}{100} \times 38450$$

$$\text{Contractor's charges} = 38450/-$$



Grand Total = 38450 + 576.75 + 3845.0

Grand Total = Rs. 42871.75

## Labour Required

Name of Work	PCC	RCC	Brickwork	Plastering	Painting	Flooring
Quantity	10m <sup>3</sup>	10m <sup>3</sup>	10m <sup>3</sup>	10m <sup>2</sup>	10m <sup>2</sup>	10m <sup>2</sup>
Head Mason	1/4	1/2	1/2	1/2	-	0.10
Mason	2	2	8	1	1	1
Male Mazdoor	11	16	7	2	2	2
Coolie/Woman Mazdoor	8	12	6	2	6	2
Bhisti	2	3	2	3/4	-	1/2
Blacksmith	-	8	-	-	-	-
Carpenter	-	8	-	-	-	-
Painter	-	-	-	-	-	-
Polisher	-	-	-	-	8	-
						10

Note :- Here  $\frac{1}{2}$  labour indicates one labour for half day.

## Cost of Labour

Head Mason	Rs. 500 Per day
Mason	Rs. 450 Per day
Mazdoor	Rs. 350 Per day
Coolie	Rs. 300 Per day
Bhisti	Rs. 250 Per day
Blacksmith	Rs. 450 Per day
Carpenter	Rs. 450 Per day
Tool & Plant	Rs. 400 Lumpsum
scaffolding	Rs. 500 Lumpsum

Lumpsum:- While preparing an estimate, it is not possible to work out in detail in case of petty items. such items are called lumpsum.

## Preparing rate analysis of RCC Work :-

Q1) Prepare rate analysis for a RCC Work with M15 grade of concrete & Vol.<sup>m</sup> = 10 m<sup>3</sup>.

Sol.<sup>n</sup> :- Given :- Concrete Grade = M15 (1:2:4)  
Vol.<sup>m</sup> = 10 m<sup>3</sup>

Add 52% extra for voids to get dry Vol.<sup>m</sup> of concrete

$$\text{Vol.<sup>m</sup> of dry concrete} = 1.52 \times 10 \\ = 15.2 \text{ m}^3$$

$$\text{i) Quantity of cement} = \frac{\text{Vol.<sup>m</sup> of dry concrete}}{\text{concrete Grade}} \times \text{cement of concrete Grade}$$

$$= \frac{15.2}{(1+2+4)} \times 1$$

$$= 2.17 \text{ m}^3$$

$$\text{No. of bags} = 2.17 \times 28.5 \\ = 61.84 \approx 62 \text{ bags}$$

OR

$$\text{No. of bags} = 2.17 \times 1440 = \frac{3124.8}{50} = 62.49 \approx 63 \text{ bags}$$

↓  
density of cement

$$\text{ii) Quantity of Sand} = \frac{15.2}{(1+2+4)} \times 2 \\ = 4.34 \text{ m}^3$$

$$\text{iii) Quantity of Aggregate} = \left( \frac{15.2}{1+2+4} \right) \times 4 \\ = 8.68 \text{ m}^3$$



iv) Quantity of steel,

let 1% steel of Vol.<sup>m</sup>

$$\begin{aligned}\text{Quantity of steel} &= \frac{1}{100} \times 10 \\ &= 0.1 \text{ m}^3\end{aligned}$$

We know the density of steel = 7850 kg/m<sup>3</sup>

$$\begin{aligned}\text{So, Wt. of steel} &= 0.1 \times 7850 \\ &= 785 \text{ kg}\end{aligned}$$

$$\begin{aligned}\text{v) Quantity of Binding wire} &= 1\% \text{ of steel} \\ &= \frac{1}{100} \times 785 \\ &= 7.85 \text{ kg}\end{aligned}$$

a) Cost of Material

S.N	Material	Unit	Qty	Rate	Amount (Rs.)
1)	Cement	Bags	62	350/-	21700
2)	Sand	m <sup>3</sup>	4.34	1000/-	4340
3)	Aggregate	m <sup>3</sup>	8.68	1200/-	10416
4)	steel	kg	785	40/-	31400
5)	Binding wire	kg	7.85	50/-	393

Total Amount = Rs. 68249.00/-

## B) Cost of Labour

S/N	Laborer	Men (Nos)	Rate	Per Day	Amount (Rs.)
1)	Head Mason	1/2	500/-	Per Day	<del>400</del> 250/-
2)	Mason	2	450	-  -	900/-
3)	Male Mazdoor	16	350	-  -	5600/-
4)	Women Mazdoor	12	300	-  -	3600/-
	Coolie	8			
5)	Bhisti	3	250	-  -	750/-
6)	T & P	lumpsum	400	lumpsum	400/-
7)	Scaffolding	lumpsum	500	lumpsum	500/-
8)	Blacksmith	8	450	Per day	3600/-
9)	Mazdoor	8	350	-  -	2800/-
10)	Carpenter	8	450	-  -	3600/-
11)	Mazdoor	8	350	-  -	2800/-

Total Amount = 24800 Rs/-

$$\begin{aligned} \text{Total cost} &= \text{Cost of Material} + \text{Cost of labour} \\ &= 68249 + 24800 \end{aligned}$$

$$\text{Total cost} = 93049 \text{ Rs. -}$$

$$\begin{aligned} \text{Add Water charges } 1.5\% \text{ of total cost,} \\ &= \frac{1.5}{100} \times 93049 \\ &= 1395.73 \text{ Rs./-} \end{aligned}$$

$$\begin{aligned} \text{Add Contractor cost } 10\% \text{ of total cost,} \\ &= \frac{10}{100} \times 93049 \\ &= 9304.9 \text{ Rs./-} \end{aligned}$$

$$\begin{aligned} \text{Grand total cost} &= \text{Total cost} + \text{Water charges} + \text{Contractor charges} \\ &= 93049 + 1395.73 + 9304.9 \end{aligned}$$

$$\text{Grand total cost} = 103749.63 \text{ Rs./-}$$



## Preparing rate analysis of Plastering Work

Q.1 Prepare rate analysis for a plastering work in cement mortar (1:6); Area =  $100\text{m}^2$

Sol.<sup>n</sup>:-      Given:-      Area =  $100\text{m}^2$   
~~20mm~~ Thickness of plaster =  $20\text{mm} = 0.02\text{m}$   
Volume = Area  $\times$  thickness  
Volume =  $100 \times 0.02$   
=  $2\text{m}^3$

But plastering has been done on both side of wall then the total vol.<sup>m</sup> of wall =  $2 \times 2 = 4\text{m}^3$

Add 30% for unevenness & 25% for voids to volume of dry mortar.

$$\text{Vol.}^{\text{m}} \text{ of dry mortar} = 1.55 \times 4 = 6.2\text{m}^3$$

$$\begin{aligned} \text{① Quantity of cement} &= \frac{6.2}{(1+6)} \times 1 \\ &= 0.88\text{m}^3 \\ &= 0.88 \times 28.5 \\ &= 25.08 \text{ bags} \approx 26 \text{ bags} \end{aligned}$$

$$\begin{aligned} \text{② Quantity of sand} &= \frac{6.2}{(1+6)} \times 6 \\ &= 5.81\text{m}^3 \end{aligned}$$

a) Cost of materials

S.N	Material	Unit	Qty	Rate	Amount
1)	Cement	Bags	26	350	9100/-
2)	Sand	m <sup>3</sup>	5.31	1000	5310/-

Total Amount = 14410/-

b) Cost of labours

S.N	Labour	Nos	Rate	Per Day	Amount
1)	Head Mason	1/3	500	Per Day	<del>166.66</del> 166.66
2)	Mason	10	450	Per Day	4500
3)	Male Mazdoor	15	350	-  -	5250
4)	Coolie	2	300	-  -	600
5)	Bhisti	1	250	-  -	250
6)	T&P	lumpsum	400	-	400
7)	Scaffolding	-  -	500	-	500

Total Amount = 11666.66 Rs./-

$$\begin{aligned} \text{Total cost} &= \text{Cost of Material} + \text{Cost of laborer} \\ &= 14410 + 11666.66 \\ &= 26076.66 \text{ Rs./-} \end{aligned}$$

$$\begin{aligned} \text{Water charge } 1.5\% \text{ of Total cost} &\Rightarrow \frac{1.5}{100} \times 26076.66 \\ &= 391.149 \text{ Rs./-} \end{aligned}$$

$$\begin{aligned} \text{Contractor charge } 10\% \text{ of total cost} &= \frac{10}{100} \times 26076.66 \\ &= 2607.66 \text{ Rs./-} \end{aligned}$$

$$\begin{aligned} \text{Grand Total} &= \text{Total cost} + \text{Water charge} + \text{contractor charge} \\ &= 26076.66 + 391.149 + 2607.66 \\ &= 29075.469 \approx 29076 \text{ Rs./-} \end{aligned}$$



$$\text{Rate of Work Per } 1\text{m}^2 = \frac{29076}{150} = \text{Rs. } 244.69 \approx 290.76 \approx 291 \text{ Rs./-}$$

### Preparing rate analysis of differ Flooring :-

Q. ① Prepare rate analysis for vitrified tile flooring over 20mm lime mortar bed. take, Area = 100m<sup>2</sup>, Vitrified tiles of size = 20cm x 20cm., lime mortar Ratio = 1:2:4

Sol.<sup>n</sup> :-

Given :- Area = 100m<sup>2</sup>, Thickness (t) = 20mm = 0.02m  
vitrified tiles for size = 20cm x 20cm = 0.20m x 0.20m

Proportion of lime mortar = 1:2:4

$$\begin{aligned} \text{Volume of lime mortar} &= \text{Area} \times \text{Thickness} \\ &= 100 \times 0.02 \\ &= 2\text{m}^3 \end{aligned}$$

for Dry volume of mortar, Add 30% for unevenness & 25% for voids to volume of dry mortar

$$\begin{aligned} \text{Vol.}^m \text{ of Dry mortar} &= 1.55 \times 2 \\ &= 3.1\text{m}^3 \end{aligned}$$

$$\text{i) Quantity of cement} = \frac{\text{Vol.}^m \text{ of Dry mortar}}{\text{lime mortar Ratio}} \times \text{Proportion of cement}$$

$$\begin{aligned} &= \left( \frac{3.1}{1+2+4} \right) \times 1 \\ &= 0.44\text{m}^3 \end{aligned}$$

$$= 0.44 \times 28.5 = 12.54 \approx 13 \text{ bags}$$

∴ For neat slurry & for joints take = 5 bags etc.

$$\text{Total no. of bags} = 13 + 5 = \underline{18 \text{ bags}}$$

$$\textcircled{i} \text{ Volume / Quantity of Sand lime} = \frac{\text{dry Vol.}^{\text{m}^3}}{\text{sum of Proportio}} \times \text{Proportion of lime}$$

$$= \left( \frac{3.1}{1+2+4} \right) \times 2$$

$$= 0.88 \text{ m}^3$$

$$= 0.88 \times \text{Density of lime}$$

$$= 0.88 \text{ m}^3 \times 3340 \text{ kg/m}^3$$

$$= 2939.2 \approx 2940 \text{ kg}$$

$$\textcircled{ii} \text{ Quantity of sand} = \frac{\text{Dry Vol.}^{\text{m}^3}}{\text{Sum of Proportion}} \times \text{Proportion of sand}$$

$$= \left( \frac{3.1}{1+2+4} \right) \times 4$$

$$= 1.77 \text{ m}^3$$

$$\textcircled{iv} \text{ No. of Tiles} = \frac{\text{Area of tile flooring}}{\text{size of one tile}}$$

$$= \frac{100}{0.20 \times 0.20}$$

$$= 2500 \text{ Nos.}$$

A) Cost of Material for 100m<sup>2</sup> of flooring Work:-

S.N	Materials	Qty	Rate	Per	Amount (Rs)
1)	Cement	18 bags	350/-	Bag	6300/-
2)	lime	2940 kg	6/-	kg	17640/-
3)	Sand	1.77 m <sup>3</sup>	1000/-	m <sup>3</sup>	1770/-
4)	Vitrified Tiles	100m <sup>2</sup>	1000/-	m <sup>2</sup>	1,00,000/-
5)	laying & Polishing	100m <sup>2</sup>	100/-	m <sup>2</sup>	10,000/-
6)	Oxalic acid powder	lumpsum	500/-	lumpsum	500/-

Total Amount = 136210 Rs./-





### B) Cost of labour :-

S.N	labour	Quantity	Rate	Per day	Amount (Rs.)
1)	Head Mason	1	1000/-	Day	1000/-
2)	Mason	15	600/-	-u-	9000/-
3)	Male Mazdoor	12	500/-	-u-	6000/-
4)	Female Mazdoor	10	400/-	-u-	4000/-
5)	Bhisti	2	500/-	-u-	1000/-
6)	Polisher	100	600/-	-u-	60000/-
7)	Sundries T&P	Lumpsum	1000/-	Lumpsum	1000/-

Total cost = 82000/-

Total cost = 136210 + 8.2000 = 218210 Rs./-

Add Water charges 1.5% of total cost,

$$= \frac{1.5}{100} \times \cancel{82000} 218210$$

$$= \cancel{1230/-} 3273.15/-$$

Add Contractor's cost 10% of total cost,

$$= \frac{10}{100} \times \cancel{218210} 218210$$

$$= 21821/-$$

Grand total = Total cost + Water charge + Contractor charge

$$= 218210 + 3273.15 + 21821$$

$$= 243304.15 \approx 243305 \text{ Rs./-}$$

Rate of vitrified tile flooring in lime mortar per m<sup>2</sup>,

$$= \frac{243305}{100} = 2433.05 \approx \underline{2434 \text{ Rs./-}}$$



## # District Schedule of Rates (DSR) :-

- Printed Booklet having rates of different works.
- List of different items of work.
- Serves as a guide in deciding rates of various items of work.
- If rates of Contractor differs much from DSR (District Schedule of Rates) rates, his tender may be rejected.

## # Cost of equipment, Tools and Plants (T & P) :-

- The cost of equipment and ordinary tools and plants and miscellaneous petty items (sundries) are added to the specific item rate as lump-sum. A provision of 2.5 to 3% of the labour cost is made for such items. In certain tools and plants if it is difficult to allocate their use for a particular item of rate, then the cost of such tools or plants may be allocated to the over head expenditure.
- For big works and projects where it becomes necessary to use special types of equipment like batching plants or WMM plant or dumpers or cranes for transportation of concrete mix, provisions of an amount 1% to 1.5% of the estimated cost is provided in the estimate under the head "special tools & plants".



Estimate for Earthwork

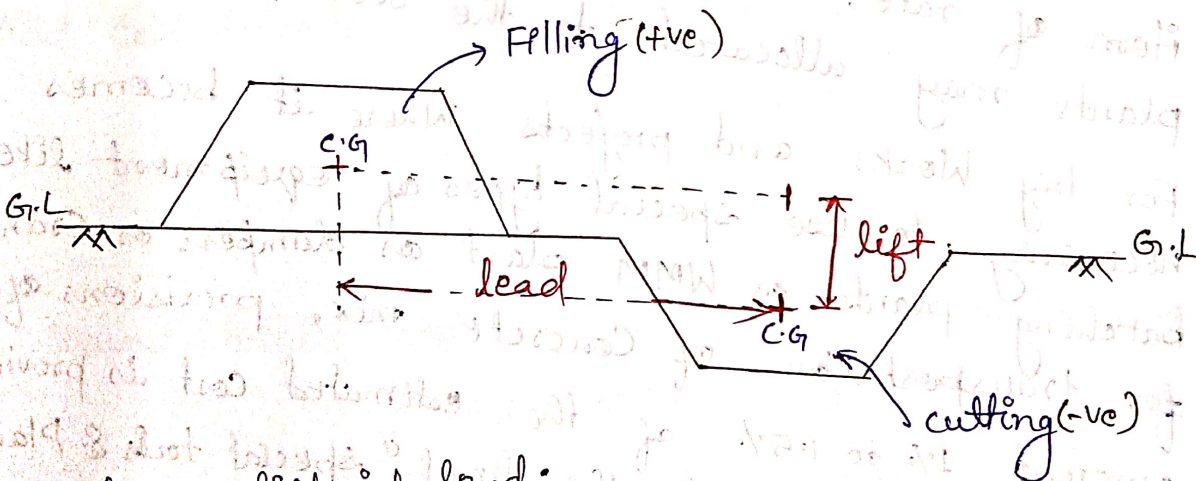
Concept of lead and lift in Earthwork :-

Lead :- It is the Horizontal distance b/w centre of gravity of cutting to the centre of gravity of filling.

- The Earthwork is generally estimated separately for each 30m lead [A/c to CPWD it is consider 50m lead]

Lift :- It is the vertical distance b/w centre of gravity of cutting [Borrow pit] to the centre of gravity of filling [Embankment].

- It is estimated for every 1.5m lift.
- first lift taken as = 2m

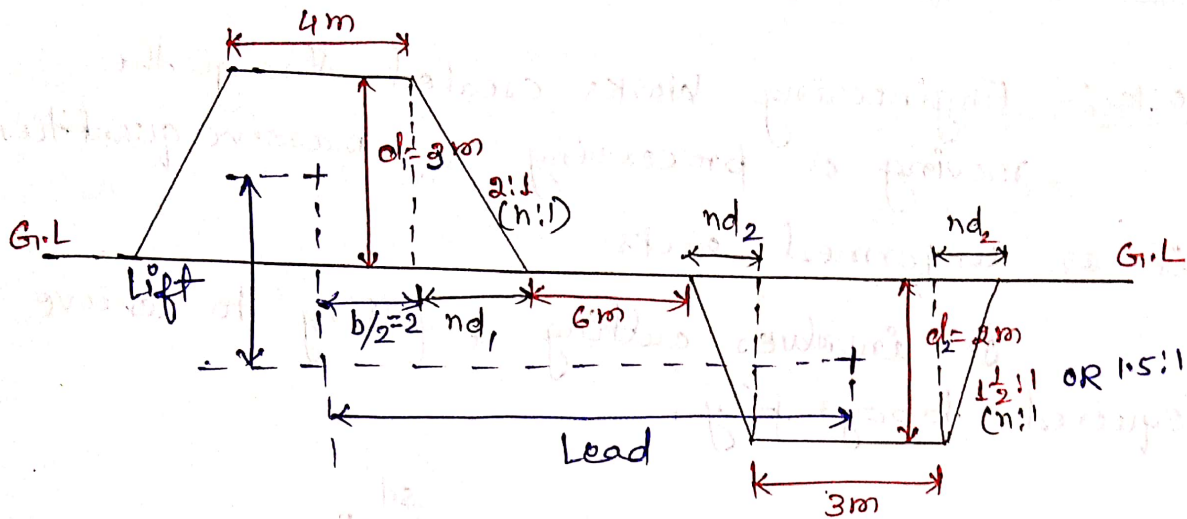


# Conversion of lift into lead :-

Lift	lead
1) 3.6m	Lift x 10
2) 3.6 - 6m	(Lift) <sup>2</sup> x 3.3
3) > 6m	Lift x 20

Q1 Find the lead & lift of Given fig & Data?

Sol.<sup>n</sup>:-



$$\begin{aligned} \text{Lead} &= \frac{b}{2} + nd_1 + \text{Distance} + nd_2 + \frac{b}{2} \\ &= \frac{4}{2} + 2 \times 3 + 6 + 1.5 \times 2 + \frac{3}{2} \\ &= 2 + 6 + 6 + 1.5 \times 2 + \frac{3}{2} \end{aligned}$$

$$\boxed{\text{Lead} = 18.5 \text{ m}}$$

$$\begin{aligned} \text{Lift} &= \frac{d_1}{2} + \frac{d_2}{2} \\ &= \frac{3}{2} + \frac{2}{2} \\ &= \frac{3}{2} + 1 \end{aligned}$$

$$\boxed{\text{Lift} = 2.5 \text{ m}} \quad \text{Ans.}$$



# # Framing estimate by taking out quantities of Earthwork of Road:

Earthwork :- Engineering Works created through the moving or processing of massive quantities of soil or unformed rocks.

It involves cutting & filling to achieve the required topography.

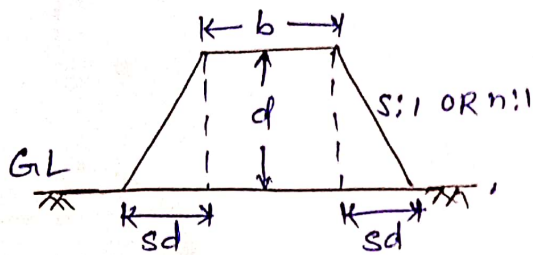


Fig:- Filling

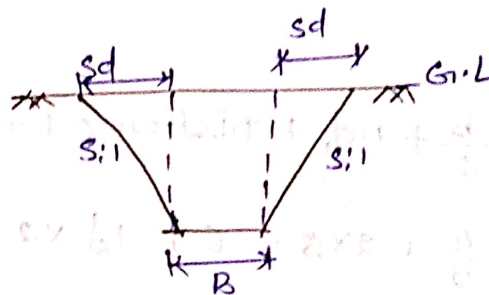
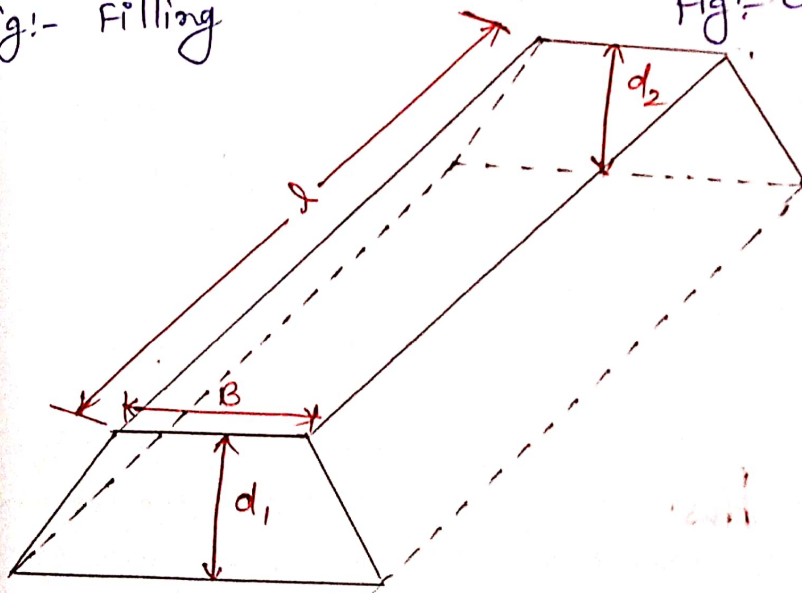


Fig:- cutting



# Quantity of Volume = sectional Area  $\times$  length

$$\begin{aligned} \text{sectional Area} &= \text{Rectangle} + \text{two side triangle} \\ &= Bd + 2\left(\frac{1}{2} \times sd \times d\right) \end{aligned}$$

$$\text{sectional Area} = Bd + sd^2$$

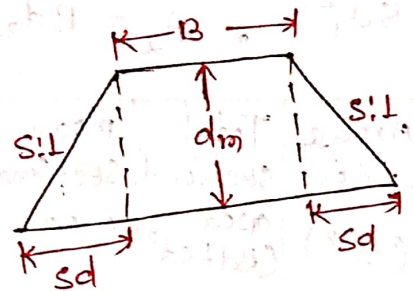
$$\text{Quantity of Vol.}^{\text{m}} = (Bd + sd^2) \times l$$

# The quantity of earthwork calculated mainly using these three methods:-

Method ① Mid sectional Area method :-

$$\text{Quantity} = (Bd_m + sd_m^2) \times l$$

$\therefore d_m = \text{Mean Ht.}$   
 $d_m = \frac{d_1 + d_2}{2}$



Stations or chainage	Depth or Ht.	Mean Depth or Ht. ( $d_m$ )	Area of central portion ( $Bd_m$ )	Area of sides ( $sd_m^2$ )	Total sectional Area $Bd_m + sd_m^2$	Length b/w stations 'L'	Quantity $(Bd_m + sd_m^2) \times l$	
							Filling	Cutting

Area of side sloping surface:-

The mean sloping breadth =  $\sqrt{sd_m^2 + d_m^2}$   
 $= d_m \sqrt{s^2 + 1}$

$\therefore$  [By Pythagoras Property]

Where  $d_m = \text{mean depth}$

Area of Both side slopes =  $2 \times (d_m \sqrt{s^2 + 1}) \times l$

Station or chainage	Depth or Height	Mean depth or Height	Breadth of side slopes $d_m \sqrt{s^2 + 1}$	length b/w stations	Total Area of both side slopes $2 \times d_m \sqrt{s^2 + 1}$



## Method (2): Mean Sectional Area Method:-

$$\begin{aligned} \text{Quantity} &= (\text{Mean sectional Area}) \times \text{length} \\ &= \left( \frac{A_1 + A_2}{2} \right) \times l \end{aligned}$$

Where:-  $A_1 = Bd_1 + Sd_1^2$  ,  $A_2 = Bd_2 + Sd_2^2$

Stations or Chainage	Ht. or Depth (d)	Area of central portion (Bd)	Area of sides ( $Sd^2$ )	Total sectional area ( $Bd + Sd^2$ )	Mean Sectional Area	Length b/w station (l)	Quantity ( $(Bd + Sd^2) \times l$ ) cutting Filling

## Method (3): Prismoidal Formula Method:-

$$\text{Quantity} = \frac{L}{6} [A_1 + A_2 + 4A_m] \quad \text{Where } A_m = \frac{A_1 + A_2}{2}$$

Note:- Earthwork calculated by method III is more accurate than calculated by method I & method II, but they will differ by less than 1%.

# For a series of cross-section:-

a) Trapezoidal rule/End rule:-

$$\text{Quantity} = d \left\{ \left( \frac{A_1 + A_n}{2} \right) + (A_2 + A_3 + \dots + A_{n-1}) \right\}$$

Where,  $A_1, A_2, A_3, \dots, A_{n-1}, A_n$  are areas of c/s



b) Simpson's Rule / Prismoidal Rule:-

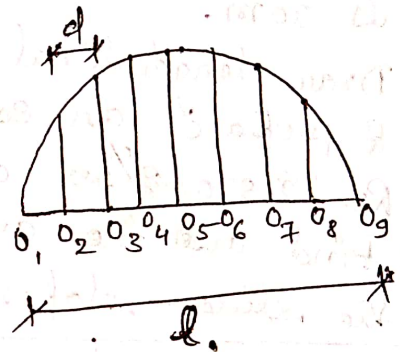
$$\text{Quantity / Vol.}^m = \frac{d}{3} \left\{ (1^{\text{st}} \text{ Area} + \text{Last Area}) + 4 \sum \text{odd areas} + 2 \sum \text{Even Areas} \right\}$$

$$= \frac{d}{3} \left\{ (A_1 + A_n) + 4(A_2 + A_4 + \dots) + 2(A_3 + A_5 + \dots) \right\}$$

# For Irregular Boundaries :-

1) Average ordinate Method :-

$$\text{Area} = l \left[ \frac{O_1 + O_2 + O_3 + \dots + O_n}{n} \right]$$



Where, n = No. of ordinates

$$l = (n-1)d$$

2) Trapezoidal Method :-

$$\text{Area} = d \left[ \left( \frac{O_1 + O_n}{2} \right) + O_2 + O_3 + O_4 + \dots + O_{n-1} \right]$$

3) Prismoidal formula :-

$$\text{Area} = \frac{d}{3} \left[ (1^{\text{st}} \text{ Area} + \text{last Area}) + 4 \sum \text{odd ordinates} + 2 \sum \text{even ordinates} \right]$$

Note:- It is applicable only for odd no. of ordinate.





# Road Earthwork

Q.1 Reduced level (R.L.) of ground along the centre line of proposed road from chainage 10 to chainage 20 are given below. The formation level of 10th chainage is 107 and the road is in downward gradient of 1 in 150 upto the chainage 14 and then the gradient changes to 1 in 100 downward. formation width of road is 10m & side slope of banking are 2:1 (H:V) length of the chain is 30m.

- Draw longitudinal section of the road & a typical cross-section & prepare an estimate of earthwork at the rate of Rs. 275.00 per cum.
- Find also the area of side slopes & the cost of the side slopes at rate of Rs. 60 per sq.m

Chainage	10	11	12	13	14	15	16	17	18	19	20
R.L. of Ground	105	105.6	105.44	105.9	105.42	104.3	105	104.1	104.62	104	103.3

Sol<sup>n</sup>:-

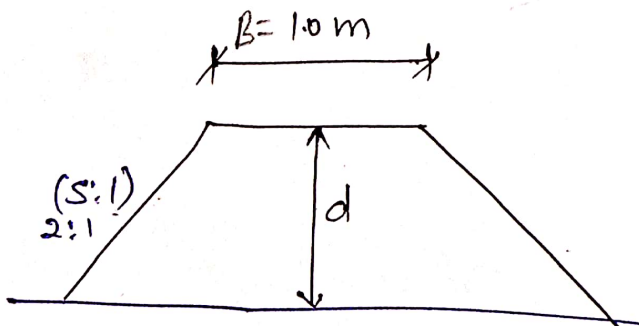
Given:-

Formation level of 10th chainage = 107

Formation width of road = 10m

S:L = 2:1

Length of chain = 30m



1 in 150

1 in 100

Chainage	10	11	12	13	14	15	16	17	18	19	20
Distance (m)	$30 \times 10 = 300$	$30 \times 11 = 330$	$30 \times 12 = 360$	$30 \times 13 = 390$	$30 \times 14 = 420$	$30 \times 15 = 450$	$30 \times 16 = 480$	$30 \times 17 = 510$	$30 \times 18 = 540$	$30 \times 19 = 570$	$30 \times 20 = 600$
R.L of G.L	105	105.6	105.44	105.9	105.42	104.3	105	104.1	104.62	104	103.3
R.L of formation	107	106.8	106.6	106.4	106.2	105.9	105.6	105.3	105	104.7	104.4
Ht. of Bank	2	1.2	1.16	0.5	0.78	1.6	0.6	1.2	0.38	0.7	1.1

a) Downward gradient = 1 in 150 upto chainage 14

$$\text{so } \Rightarrow \frac{1}{150} \times 30 = 0.2 \text{ (length)}$$

Note:- for R.L of formation minus 0.2 from just before R.L upto 14 chainage

b) Downward gradient = 1 in 100 ~~upto~~ from 15 chainage to 20 chainage

$$\text{so } \Rightarrow \frac{1}{100} \times 30 = 0.3$$

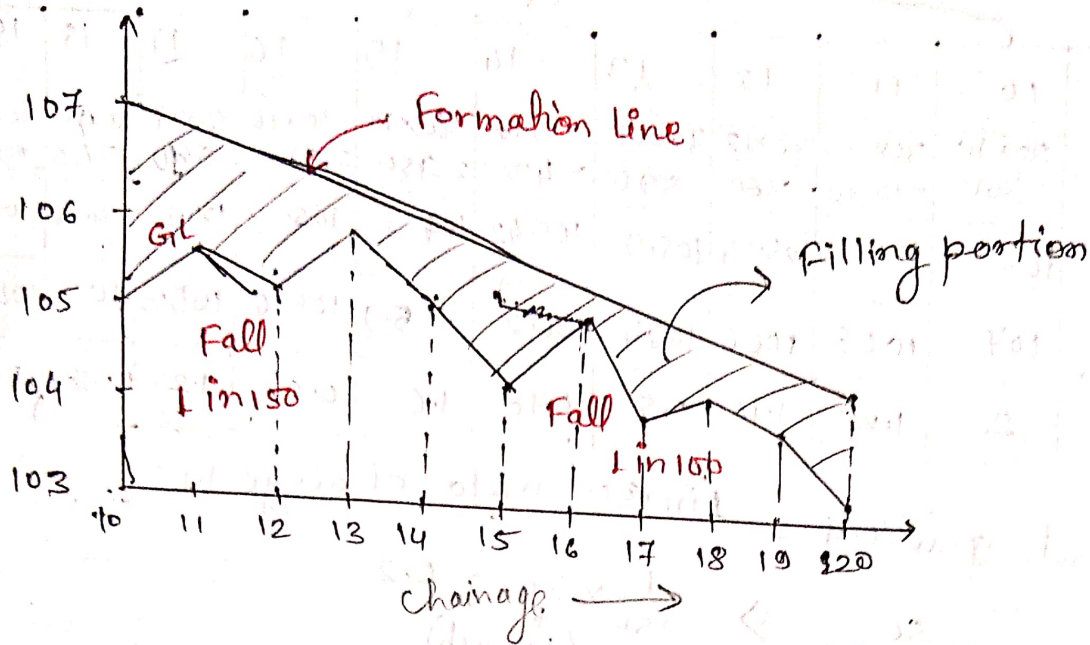
Note:- for R.L of formation minus 0.3 from just before R.L upto from 15 chainage to 20 chainage.

for 10th chainage:-

$$\begin{aligned} \text{Ht. of Bank} &= \text{R.L of formation} - \text{R.L of G.L} \\ &= 107 - 105 \\ &= 2 \end{aligned}$$

[Same process for further chainage]





Calculation of earthwork quantities by  
"Mid sectional Area method" :-

Station or chainage	Length (m) [L x chainage] d	Ht. or Depth (m)	Mean Ht. (m) d <sub>m</sub>	Central Area (m <sup>2</sup> ) (Bd <sub>m</sub> ) 10 x d <sub>m</sub>	Side area (m <sup>2</sup> ) (Sd <sub>m</sub> ) d	Total sectional Area (m <sup>2</sup> ) (Bd <sub>m</sub> + Sd <sub>m</sub> )	Length b/w station (L)	Quantity (Bd <sub>m</sub> + Sd <sub>m</sub> ) x L	
								Filling (m <sup>3</sup> )	Cutting (m <sup>3</sup> )
10	300	2	-	-	-	-	-	-	-
11	330	1.2	1.6	16	5.12	21.12	30	633.6	
12	360	1.16	1.18	11.80	2.78	14.58	30	437.6	
13	390	0.5	0.83	8.3	1.38	9.68	30	290.4	
14	420	0.78	0.64	6.40	0.82	7.22	30	216.6	
15	450	1.6	1.19	11.9	2.83	14.73	30	441.9	
16	480	0.6	1.1	11.0	2.42	13.42	30	402.6	
17	540	1.2	0.9	9.0	1.62	10.62	30	318.6	
18	540	0.38	0.79	7.90	1.25	9.15	30	274.5	
19	570	0.7	0.54	5.40	0.58	5.98	30	179.4	
20	600	1.1	0.90	9.0	1.62	10.62	30	318.6	

Total = 3513.6 m<sup>3</sup>

$$Sd_m^2 \times (1.6)^2$$



## Abstract of estimated cost :-

S.N	Item	Qty	unit	Rate	Per	Cost/Amount
1	Earthwork in filling	3513.6	cum	Rs 275	1/cum	9662.40

Total - Rs. 9662.40

Add 5% [3% for contingencies & 2% for work charged establishment] of total cost,

$$= 9662.40 \times \frac{5}{100}$$

$$= \underline{Rs. 483.12}$$

Grand Total =  $9662.40 + 483.12 = \underline{Rs. 10145.52}$

Calculation Area of side slope :-

BxL

Station or chainage	Depth or Ht. (m)	Mean depth (m)	sloping breadth $d_m \sqrt{s^2+1}$	Length (L)	Area of both side slope $2 \times [L \times d_m \sqrt{s^2+1}]$
10	2	-	-	-	-
11	1.2	1.6	3.58	30	214.66
12	1.16	1.18	2.64	30	158.31
13	0.50	0.83	1.86	30	111.35
14	0.78	0.64	1.43	30	85.86
15	1.60	1.19	2.66	30	159.65
16	0.6	1.10	2.46	30	147.58
17	1.2	0.90	2.01	30	120.74
18	0.38	0.79	1.77	30	105.99
19	0.70	0.54	1.21	30	72.45
20	1.10	0.90	2.01	30	120.74

Total = 1297.80m<sup>2</sup>





Q. 2) Calculate the quantities of earthwork in cutting & in banking (filling) for a portion of road with following data:-

- i) Formation width of road is 12m.
  - ii) Formation level & of starting chainage is 51.40m.
  - iii) The road surface shall be given a falling gradient of 1 in 200.
  - iv) Side slopes are 1V:2H in banking & 1V:1.5H in cutting.
- length of chain = 30m.

chainage in m	0	30	60	90	120	150	180
G.L in (m)	50.8	50.6	50.7	51.2	51.4	51.3	51.0

Sol.<sup>n</sup>:-

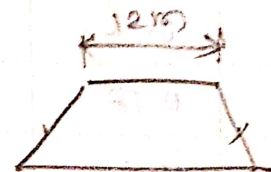
Ht of cutting				0.25	0.6	0.65	0.5
Ht. of Banking (Filling)	0.6	0.65	0.4				
R.L of formation	51.40	51.25	51.10	50.95	50.80	50.65	50.5
R.L of G.L	50.8	50.6	50.7	51.2	51.4	51.3	51.0
Distance (d) $\left\{ \begin{array}{l} \text{Sch.} \\ \times \\ \text{d} \end{array} \right.$	0	900	$\frac{1800}{2}$	$\frac{2700}{2}$	3600	4500	5400
Chainage	0	30	60	90	120	150	180

falling Gradient = 1 in 200

$$= \frac{1}{200} \times \text{length}$$

$$= \frac{1}{200} \times 30$$

$$= 0.15\text{m}$$



Note:- For R.L of formation minus 0.15m from just before R.L

$$\text{Ht. of Banking} = \text{R.L of formation} - \text{R.L of G.L}$$

for 10th chainage,

$$\begin{aligned}\text{Ht. of Banking} &= 51.40 - 50.8 \\ &= 0.6 \text{ m}\end{aligned}$$

for 20th chainage,

$$\begin{aligned}\text{Ht. of Banking} &= 51.25 - 50.6 \\ &= 0.65 \text{ m}\end{aligned}$$

for 60th chainage,

$$\begin{aligned}\text{Ht. of Banking} &= 51.10 - 50.7 \\ &= 0.4 \text{ m}\end{aligned}$$

Note:- Find upto chainage 180 if value will -ve then take  
Also, as Ht. of cutting,

$$\text{Ht. of cutting} = \text{R.L of G.L} - \text{R.L of formation}$$

for 90th chainage,

$$\begin{aligned}\text{Ht. of cutting} &= 51.2 - 50.95 \\ &= 0.25 \text{ m}\end{aligned}$$

for 120th chainage,

$$\begin{aligned}\text{Ht. of cutting} &= 51.4 - 50.80 \\ &= 0.6 \text{ m}\end{aligned}$$

for 150th chainage,

$$\begin{aligned}\text{Ht. of cutting} &= 51.3 - 50.65 \\ &= 0.65 \text{ m}\end{aligned}$$

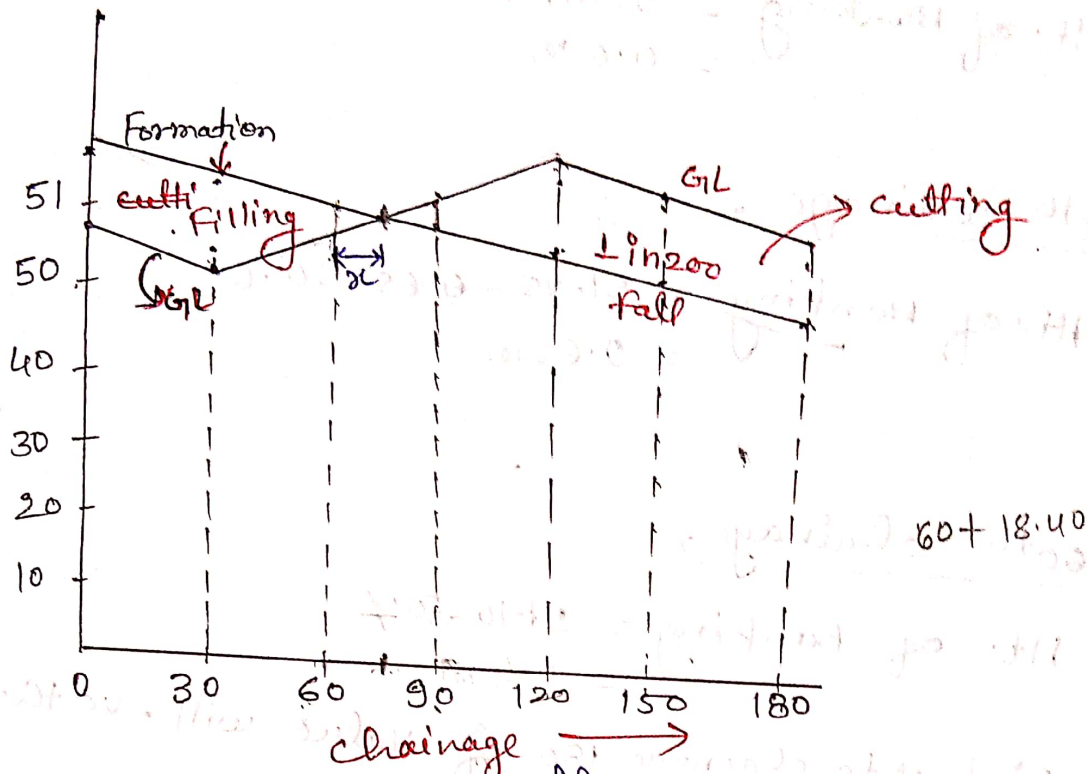
For 180th chainage,

$$\begin{aligned}\text{Ht. of cutting} &= 51.0 - 50.5 \\ &= 0.5 \text{ m}\end{aligned}$$

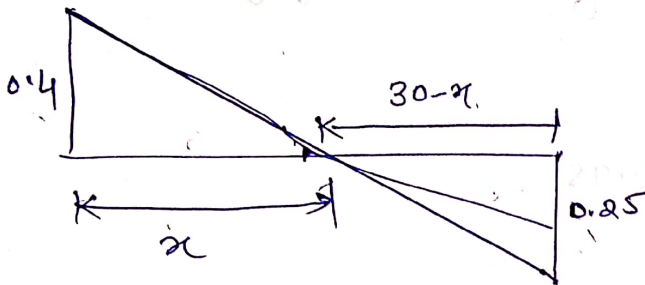


for 90th chainage,

Ht of cutting = .



chainage of zero depth,



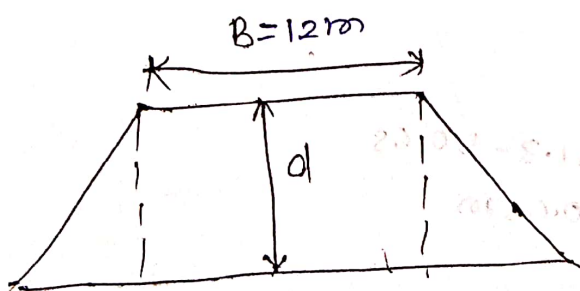
By similar triangle,

$$\frac{x}{30-x} = \frac{0.4}{0.25}$$

$$0.25x = 0.4(30-x)$$

$$x = 18.46m$$

A/c to Mid sectional Area method :-



side slope in cutting,

1V: 2H

in side slope in Filling,

1V: 1.5H

Station	Length (m)	Depth (m)	Mean Ht. (m)	Central area (m <sup>2</sup> )	Side area (m <sup>2</sup> )	Total area (m <sup>2</sup> )	Length (m)	Quantity [Bdnt Sdm] x L	
								Banking (m <sup>3</sup> )	Cutting (m <sup>3</sup> )
0	0	0.6	—	—	—	—	—	—	—
30	900	0.65	0.625	7.5	0.781	8.281	30	248.43	
60	1800	0.4	0.525	6.3	0.551	6.851	30	205.53	
78.46	2353.8	0	0.2	2.4	0.08	2.48	18.46	45.78	
90	2700	0.25	0.125	1.5	0.023	1.523	11.54		17.575
120	3600	0.6	0.425	5.1	0.271	5.371	30		161.13
150	4500	0.65	0.625	7.5	0.586	8.086	30		242.58
180	5400	0.5	0.575	6.86	0.496	7.356	30		220.68
Total =								499.74 m <sup>3</sup>	641.96 m <sup>3</sup>