

ESTIMATION AND COSTING

ESTIMATE: An estimate is the anticipated or probable cost of work and is usually prepared before the construction is taken up. Before undertaking any work or project it is necessary to know its probable cost which is obtained or derived by estimating. The estimate is prepared by computing or calculating the quantities required and then calculating the cost at suitable rates, to get the expenditure likely to be incurred in the construction of the work or structure.

Different types of estimate are following:-

- (i) Preliminary estimate or approximate or abstract estimate or Rough cost estimate.
- (ii) Plinth Area estimate
- (iii) Cube Rate estimate or cubical content estimate
- (iv) Approximate quantity method estimate.
- (v) Detailed estimate or item rate estimate.
- (vi) Revised estimate
- (vii) Supplementary estimate.
- (viii) Supplementary and Revised estimate.
- (ix) Annual Repair or maintenance estimate.

(i) PRELIMINARY ESTIMATE :

- (a) It is used to ascertain the actual cost forecast of a project.
- (b) Assist the client in knowing to what extent he need to be financially committed to a particular project.
- (c) Estimated is also function as the design guide whether the project to the allocation mode either.

(ii) PLINTH AREA ESTIMATE :

This is prepared on the basis of plinth area of building, the rate being deducted from the cost of similar building having similar specification, heights and construction in the locality. Plinth area estimate is calculated by finding the plinth area of building and multiplying by the plinth area rate. The plinth area should be calculated for the covered area by taking external dimension of the building at the floor level. Courtyard and other open area should not be included in the plinth area. Plinth area estimate is only approximate and is a preliminary estimate, to know the approximate cost before hand.

(iii) CUBE RATE ESTIMATE FOR BUILDING :

Cube Rate Estimate is a preliminary estimate or an approximate estimate and is prepared on the basis of the cubical contents of the building. The cube rate being deducted from the cost of the similar building having similar specification and construction in the locality.

This is calculated by finding the cubical content of the building($\text{length} \times \text{breadth} \times \text{height}$) and multiplied it by the cube rate. The length and breath should be taken as the external dimensions of the buildings at the floor levels and the height should be taken from the floor level to top of roof (or half way of the sloped roof).

(iv) APPROXIMATE QUANTITY METHOD ESTIMATE

In this method approximate total length of walls is found in running metre and this total length multiplied by the rate per running metre of wall gives a fairly accurate cost. For this method the structure may be divided into two parts viz

- (i) foundation including plinth and
- (ii) Superstructure.

The running metre cost for foundation and superstructure should be calculated first and these running metre rate should be multiplied by the total length of walls.

(v) DETAILED ESTIMATE OR ITEM RATE ESTIMATE :

Detailed estimate is an accurate estimate and consist of working out the quantities of each item of works, and working the cost. The dimensions, length, breadth and height of each item are taken out correctly from drawing and quantities of each item are calculated and abstracting and billing are done.

(vi) REVISED ESTIMATE :

Revised estimate is a detailed estimate and is required to be prepared under any of the following circumstances:-

- (a) When the original sanctioned estimate is exceeded or likely to exceed by more than 5%
- (b) When the expenditure on a work exceeds or likely to exceed the amount of administrative sanction by more than 10%

(vii) SUPPLEMENTARY ESTIMATE :

Supplementary estimate is a detailed estimate and is prepared when additional works are required to supplement the original work. This is a fresh detailed estimate of the additional works in addition to the original estimate.

(viii) SUPPLEMENTARY AND REVISED ESTIMATE :

When a work is partially abandoned and the estimated cost of the remaining work is less than 95% of the original work, that is less than 95% of the original sanctioned estimate, or when these are

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material deviations and changes in the design which may cause substantial saving in the estimate then the amount of the original estimate is revised by the competent authority.

(ix) **ANNUAL REPAIR OR MAINTENANCE ESTIMATE :**

Annual Repair or annual maintenance estimate is a detailed estimate and is prepared to maintain the structure or work in proper order and safe condition.

GLOSSARY OF TECHNICAL TERM:

A glossary of terms relating to construction cost estimating are following:-

- (i) **Basis of estimate :** A document which describes the scope basis, pricing basis, methods, qualifications, assumptions, inclusions and exclusions.
- (ii) **Bond :** Usually refers to a performance bond, which is a security bond issued by an insurance company or a bank to guarantee satisfactory completion of a project by a contractor.
- (iii) **Construction Cost :** The total cost to construct a project. This value usually does not include the preplanning site or right of way acquisition or design costs and may not include start -up and commissioning costs. This total or subtotal is usually identified as such in an estimate report. Also known as total estimated contract cost(TECC).
- (iv) **Contingency :** When estimating the cost for a project, product or services or other item or investment, there is always uncertainty as to the precise content of all items in the estimate, how work will be performed, what work condition will be performed, what work conditions will be like when the project is executed and so on. These uncertainties are risks to the project.
- (v) **Cost Index :** A value used to adjust the cost of from one time to another. There are various published cost indexes, listed by year, quarter or month. Rs means publishes a historical cost index.

ANALYSIS OF RATES : The determination of rate per unit of a particular item of work from the cost of quantities of materials, the cost of labours and other miscellaneous petty expense require for its completion is known as the analysis of rate. A reasonable profit, usually 10% for the contractor is also included in the analysis of rate. Rates of material are 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 materials are to be carried from a distant place, more than 8 kms(5miles), then cost of transport is also added. the rates of materials and labour vary from place to place and therefore the rates of different items of work also vary from place to place.

The rates of a particular item of work depends on the following:-

- (i) Specifications of works and materials, quality of materials, proportion of mortar method of constructional operation etc.
- (ii) Quantities of materials and their rates, number of different types of labour and their rates.
- (iii) Location of the site of work and its distances from the sources of materials and the rate of transport availability of water.
- (iv) Profits and miscellaneous and overhead expenses of contractor.

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.

(1) **General overhead :**

- (a) Establishment
- (b) Stationery , printing, postages, etc.
- (c) Travelling expenses
- (d) Telephone
- (e) Rent and taxes

(ii) **Job overhead :**

- (a) Supervision(salary or engineers, overseers, supervision)
- (b) Handling of materials,
- (c) Repairs, carriage and depreciation of T and P
- (d) Amenities of labour
- (e) Workmen's compensation insurance,etc
- (f) interest on investment
- (g) Losses on advances.

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

- (i) Materials and (ii) labour and their costs added together give the cost of the item of work. The costs of materials are taken as delivered at site inclusive of the transport, local taxes and other charge. For tools and plants and miscellaneous petty items which cannot be accounted in details lump-sum provision is made. A provision for wa-

ter charges @ $1\frac{1}{2}\%$ of the total cost is made in rate.

(2) **TASK OR OUT - TURN WORK :**

Task : 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 then the out-turn is greater than small towns and country sides. In well organised work, less labour is required.

The following may be taken as the approximate quantity of work or out-turn or task for an average artisan per day.

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Particulars of items	Quantity	Per day
1. Brickwork in lime or cement mortar in foundation and plinth.	1.25 cum	(45cuft) per mason.
2. -Do-in superstructure	1.00 cum	(35cuft) per mason.
3. Brick work in mud mortar in foundation and plinth.	1.50 cum	(55cuft) per mason.
4. -Do-in superstructure	1.25 cum	(45cuft) per mason.
5. Brick in cement or lime morter in arches.	0.55 cum	(20cuft) per mason.
6. -Do-in jack arches	0.55 cum	(20cuft) per mason.
7. Half brick wall in partition	5.00 sqm	(50sqft) per mason.
8. Coursed rubble stone masonry in lime or cement mortar including dressing	0.80 cum	(30cuft) per mason.
9. Random rubble stone masonry in lime or cement morter	1.00 cum	(35cuft) per mason.
10. Ashlar masonry in lime or cement mortar.	0.40 cum	(15cuft) per mason.
11. Stone arch work	0.40 cum	(15cuft) per mason.
12. Lime concrete in foundation or floor	8.50 cum	(300cuft) per mason.
13. Lime concrete in roof terracing	6.00 cum	(200cuft) per mason.
14. Cement concrete 1:2:4	5.00 cum	(175cuft) per mason.
15. R.B Work	1.00 cum	(35cuft) per mason.
16. R.C.C Work	3.00 cum	(125cuft) per mason.
17. 12mm(1/2")plastering with cement or lime . mortar	8.00 sqm	(80sq.ft) per mason.
18. Pointing with cement or lime morter	10.00 sqm	(100sq.ft) per mason.
19. White washing or colour washing three coats	70.00 sqm	(700sq.ft) per white washer.
20. White washing or colour washing one coat	200.00 sqm	(2000sq.ft) per white wash
21. Painting or varnishing doors or windows one coat	25 sqm	(250 sqft) per painter
22. Coal terring or solignum painting one coat	35.00 sqm	(350 sqft) per painter
23. Painting large surface coat	35.00 sqm	(350 sqft) per painter
24. Distempring one coat	35.00 sqm	(350 sqft) per painter
25. 2.5cm(1") C.C floor.	7.50 sqm	(75 sqft) per painter
26. Flag stone floor laying with lime or cement morter excluding L.C.	10.00 sqm	(100 sq.ft) per mason
27. Terrazo floor 6 mm thick mosaic work over 2cm thick cement concrete(1:2:4)	5.00 sqm	(50 sq.ft) per mason
28. Brick-on- edge in floor lime or cement Mortar excluding L.C	7.00 sqm	(70 sq.ft) per mason
29. Brick flat floor as in above	8.00 sqm	(80 sq.ft) per mason
30. Timber framing, sal or teak wood.	0.07 cum	(2.5cuft) per carpenter
31. -Do-Country wood.	0.15 cum	(5 cuft) per carpenter
32. Door and window shutters pannelled or glazed.	0.15 sqm	(1.5 sq.ft) per carpenter
33. -Do-battened	0.80 sqm	(18 sq.ft) per carpenter
34. Sawing hard wood	4.00 sqm	(40sq.ft) per pair of sawers.
35. Sawing of soft wood	6.00 sqm	(60sq.ft) per pair of sawers.
36. Single Allahabad tiling or Mangalore tiling	6.00 sqm	(60sq.ft) per pair of sawers.
37. Double Allahabad tiling	4.00 sqm	(40sq.ft) per tile layer.
38. Breaking of brick ballast 40mm $\left(1\frac{1}{2}''\right)$ gauge.	0.75 cum	(30cuft) per labours
39. Breaking of brick ballast 25mm(1") gauge. one coat	0.55 cum	(20cuft) per labours
40. Breaking of stone ballast 40mm $\left(1\frac{1}{2}''\right)$ gauge	0.40 cum	(15 cuft) per labourer

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41. Breaking of stone ballast 25mm(1")gauge	0.25 cum	(10 cuft) per labourer
42. Ashuir stone dressing.	0.70 cum	(25 cuft) per stone
43. Flag stone dressing.	1.50 sqm	(15 sqft) per stone
44. Earthwork in excavation in ordinary soil.	3.00 cum	(100 cuft) per beldar
45. Earthwork in excavation in hard soil.	2.00 cum	(75 cuft) per belder
46. Excavation in rock.	1.00 cum	(35 cuft) per beldar
47. Sand filling in plinth.	4.00 cum	(140 cuft) per beldar
48. Number of bricks laid by a mason in brick work upto a height of 3m(10').	600 brick	per mason
49. Amount of work done by a mazdoor (helper) per day (i) Mix (ii) Delivery brick (iii) Deliver Mortar	3 cum 4000 nos 5.5 cum	(100 cuft) mortar per mazdoor to a distance 15m per mazdoor (200 cuft) per mazdoor.
50. Scaffolding cost for single storey building	Re.0.50 per cum	(Rs. 1.5% cuft of brick work)

Item 46, 47 and 48 are based on the committee report on Rates and cost, Goverment of India.

ANALYSIS OF RATES OF DIFFERENT ITEM :

(1) Lime concrete in foundation with 40mm gauge brick Ballast unit 1 cum.Take -10 cum.

(a) With white lime and surkhi 1:2 (proportion-16:32:100) i.e,1:2:6 approx.

Particulars	Qnty or Nos.	Rate		Cost	
		Rs.	Per	Rs.	Per
Materials :					
Brick ballast 1 class 40 mm gauge	10 cum	650.00	cum	6500.00	
White lime slaked	1.6 cum	800.00	cum	1280.00	
Surkhi	3.2 cum	500.00	cum	1600.00	
		Total-		9380.00	
Labour :					
mistri(Head mason)	1/2 no.	350.00	per/d	175.00	
Mason	1 no.	300.00	per/d	300.00	
Mazdoor(Beldar)	12 nos.	220.00	per/d	2640.00	
Boy or Woman coolie	12 nos.	200.00	per/d	2400.00	
Bhishti (water-man)	2 nos.	200.00	per/d	400.00	
Sundriest and P etc	Lump Sum	100.00	L.s	100.00	
(misc petty things)		Total -		6015.00	
Total of material & Labour					15395.00
Add $\left(1\frac{1}{2}\%\right)$ water charges				231.00	
Add 10% contractor's profit				1539.50	
		Grand Total-		17165.50	
		for 10 cu m			
Rate per Cum = $\frac{17165.50}{10}$	Rs.1716.50				

Approximate calculation of materials for 100 cum L.C.

$$1:2:6, \text{ Lime} = \frac{150}{1+2+6} = 16.6 \text{cum}$$

$$\text{Surkhi} = 16.6 \times 2 = 32.2 \text{ cum}/\text{Brick ballast} = 16.6 \times 6 = 96.6 \text{ cum}$$

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(2) CEMENT CONCRETE :

Sum total quantity of determining the quantity of materials for 10 cum concrete is to divide 15.2 by the sum of the numerals of the proportion of the materials which gives the quantity of cement in cum.

Illustration:- To find the materials for 10 cum of cement of 1:4:8 proportion.

$$\text{Cement} = \frac{15.2}{1 \ 4 \ 8} = \frac{15.2}{13} = 1.17 \text{ cum} \approx 1.15 \text{ cum.}$$

Therefore, Sand= $1.15 \times 4 = 4.60$ cu m and ballast = $1.15 \times 8 = 9.20$ cu m.

Material required for different proportion of cement concrete - 10 cu m.

Quantity of material may be calculated by 15.2 as sum total and dividing by sum of the proportions.

Proportion	Ballast	Sand	Cement
1 : $1\frac{1}{2}$: 3	8.40 cum	4.20 cum	2.80 cum (84 bags)
1 : 2 : 4	8.80 cum	4.40 cum	2.20 cum (66 bags)
1 : 3 : 6	9.00 cum	4.50 cum	1.50 cum(45 bags)
1 : 4 : 8	9.20 cum	4.60 cum	1.15 cum($34\frac{1}{2}$ bags)
1 : 5 : 10	9.50 cum	4.75 cum	0.95 cum ($28\frac{1}{2}$ bags)
1 : 6 : 12	9.60 cum	4.80 cum	0.80 cum (24 bags)

(3) R.C.C work in Beams, Slabs, etc. 1 : 2 : 4 - Unit 1 Cu m.

Particulars	Qnty or Nos.	Rate	Cost
		Rs. Per	Rs. Per
Materials :			
Stone Ballast 20 mm gauge	8.80 cum	1800.00 per cum	15840.00
Sand (coarse)	4.40 cum	1500.00 per cum	6600.00
Cement(66 bags)	2.20 cum	7650.00 per cum	16830.00
Steel, mild steel bars @ 1% = 1 cum			
78.5 q/cum = 7.85q	7.85 q	4400.00 per q	34540.00
Binding wire	1.50 kg	65.00 per kg	97.50
		Total	73907.50
Labourers			
Mistri (head mason)	1/2 no.	350.00 per day	
Mason	3 nos.	300.00 per day	
Mazdoor (Beldar)	12 nos.	220.00 per day	
Boy or women coolie	20 nos.	200.00 per day	
Bhishti(including curing)	6 nos.	200.00 per day	
Sundriest and p etc	Lump Sum	1400.00 L.S	
		Total	9055.00
Bending, cranking and binding steel bars in position:			
Blacksmith(II class)	8 nos.	280.00 per day	2240.00
Mazdoor(Beldar)	8 nos.	220.00 per day	1760.00
T and P	Lump sum	90.00 L.S	90.00
		Total	4090.00

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Particulars	Qnty or Nos.	Rate	Cost
		Rs. Per	Rs. Per
Centring and shuttering (both erection and dismantling)			
Timber planks and baulies	Lump sum	1500.00 L.S	
Carpenter(IIclass)	10 nos.	280.00 per/d	
Mazdoor (Belder)	10 nos.	220.00 per/d	
Nails	Lump sum	200.00 L.S	
T and P	Lump sum	70.00 L.S	
Total of materials and labours		Total	6770.00
Add $1\frac{1}{2}\%$ water charges			85673.00
Add 10% Contractor's Profit			1285.00
			8567.00
		Grand Total-	95525.30

Rate per cum - Rs. 95525.30/10 = Rs.9552.50

(4) BRICK WORK WITH STANDARD BRICKS :

Calculation of materials required for brick work:-

Take a wall $1\frac{1}{2}$ brick thick 30cm nominal thickness of 20m length and 5m height nominal volume = $20 \times 3 \times 5 = 30$ cum normally mortar joint will be less than 1cm, taking 1 cm mortar joint, the actual thickness of wall be 29cm.

Therefore, actual volume = $20 \times 29 \times 5 = 29$ cum Number of standard bricks of 20cm \times 10cm \times 10cm \times nominal size = $\frac{29}{.20 \times .10 \times .10} = 14500$ nos.

Therefore, number of bricks per cum(nominal) = $\frac{14500}{30} = 484$ nos. considering 5% breakages, wastage etc.

This may be taken 500 nos. per cum.

For 10 cum of brickwork 5000 bricks are required.

(i) Mortar: Mortar requirement = (Total volume of brickwork) – (net volume of bricks) = $29 - (.19 \times .09 \times .09 \times 14500) = 29 - 22.315 = 6.685$ cum for frog filling, for use of cut bricks, for bonding, for uniform joints, wastage etc. 15% extra mortar may be required.

Therefore, the volume of mortar = $6.685 + 6.685 \times 0.15 = 7.688$ cum. For dry volume, it increases by 1/4. Dry volume of mortar = $7.688 + 1.922 = 9.61$ cum. For 30 cum of brickwork, dry volume of mortar= 9.61 cum for 10

cum of brickwork, dry volume of mortar = $9.61 \times \frac{10}{30} = 3.2$ cum.

In practise for cement mortar 3 cum dry mortar and for lime mortar 3.5 cum of dry mortar are taken for 10 cum brickwork. As an approximate 30% dry mortar may be taken.

(ii) Calculation of materials of mortar:

Approximate method to determine the quantity of materials or mortar for 10 cum brickwork :

Divide 3 by the sum of the numerals of the proportion of materials which gives the quantity of cement in cum. As for example for brickwork in 1.6 cement mortar cement= $\frac{3}{1+6} = 0.43$ cum of sand may be taken.

(iii) Brickwork with traditional bricks :

$$22.9 \times 11.4 \times 7. ccm (9" \times 4\frac{1}{2}" \times 3").$$

Volume of one standard brick(nominal size) = $20cm \times 10cm \times 10cm = 2000$ cu cm.

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Volume is almost same. Therefore the same quantity of bricks and mortar as for standard bricks may be taken for brickwork with traditional bricks. Thus, the analysis of rate for brick work with both type of bricks will be same. For 25.4cm × 12.7cm × 7.6 cm(10"× 5"×3") bricks 4200 bricks may be taken per 10 cum of brickworks and materials of mortar may be taken same as for standard brick.

(iv) Materials and labour required for Brickwork with different proportion of mortar for-10 cum.

Material -		Bricks	Lime	Sand or Surkhi
Proportion				
White Lime Mortar				
1 : 2		5000 nos.	1.20 cu m	2.40 cu m
1: 3		5000 nos.	0.90 cu m	2.70 cu m
Knakar Lime Mortar				
1		5000 nos.	3.00 cu m
1 : 1		5000 nos.	2.00 cu m	2.00 cu m
Mud mortar		5000 nos.	3.5 cu m earth
Cement mortar				
1: 2		5000 nos.	Cement 1.00 cum(30 bags)	Sand 2.00 cum
1 : 3		5000 nos.	0.75 cum($22\frac{1}{2}$ bags)	2.25 cum
1: 4		5000 nos.	0.60 cum(18 bags)	2.40 cum
1: 5		5000 nos.	0.50 cum (15 bags)	2.50 cum
1 : 6		5000 nos.	0.45 cum($13\frac{1}{2}$ bags)	2.70 cum

Labour : Labour may be taken same as for respective items as applicable.

Profit : 10% contractor's profit may be added as usual.

If cement is supplied by the department, 10% profit on the cost of cement should not be added but cost of transport from the godown to the site of work should be allowed and added.

(5) PLASTERING :

(i) Calculation of quantity of mortar and materials

Area x thickness gives the quantity of mortar for uniform thickness for filling up the joints and to make up un-uniform surface of wall. This may be increased by 30% which will give wet mixed mortar. To get the total dry volume of ingredient materials or mortar, the wet volume may be further increased by 25%. The quantities of each material of the mortar may be found by usual methods, dividing the dry volume of mortar by the sum of the numerals.

Materials for 12mm thick plastering in wall for 100sq m :

(i) Wet mixed mortar for uniform layer = 1.2 cu.m. Adding 30% to fill up joints uneven surfaces, etc, the quantity of mortar comes to 1.2 to 0.36 = 1.56 cu m. Increasing by 25% the total dry volume = 1.95 cu m = 2.00 cu m (say). for 1 : 6 cement sand mortar. cement

$$= \frac{2}{1+6} = .30 \text{ cu m, sand} = .30 \times 6 = 1.80 \text{ cu m. similarly}$$

the quantities of materials for other proportions may

be calculated. The quantities of materials are given ahead in this chapter.

Materials for 20mm thick plastering in wall for 100 sqm

As the thickness of plaster is more, 20% of mortar may be taken to fill up the joints, unevenness etc. The quantity of wet mortar is equal to $200 \times .02 + 20\% = 2.00 + 0.40 = 2.40 \text{ cu m.}$

Increasing by 25% the dry volume = $2.40 + 0.60 = 3.00 \text{ cu m.}$

The quantities of each material of mortar may be found by usual method.

Rich Mortar :

For rich mortar plastering the quantities of materials will be less as the cement will be in excess than the voids in sand and the reduction in volume of dry mortar will be less.

Ceiling plastering 12mm thick for 100 sq.m :

For plastering in R.C.C. ceiling, the unevenness of surfaces will be less and 20% extra mortar may be taken to get even surface. The quantity of wet mortar is equal to $100 \times .012 + 20\% = 1.2 + .24 = 1.44 \text{ cu m.}$ Increasing by 25% the dry volume = $1.44 + 0.36 = 1.80 \text{ cu m.}$

For 6mm thick plastering R.C.C ceiling the quantity of dry mortar may be taken as 1.00 cum.

For plastering in floor over lime concrete the same quantity of mortar as for wall may be taken as there will be sufficient unevenness in the surface of lime concrete.

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Neat cement flooring : For neat cement flooring finishing in floor or dado or skirting, the thickness of neat cement layer may be taken as 1.5mm ($\frac{1}{6}$ " thick), therefore the cement paste requirement for 100 sqm= $100 \times .0015 = .15$ cu m.

Dry volume of cement increased by 25% = $1.5 + .15 \times 1/4 = .19$ cu m = 2 cu m(say) = 6 bags per 100 sq.m

(ii) Materials required for plastering with different mortars of various proportions for 100 sqm:

For 12mm thick plastering, total dry volume 2 cu m:

MORTAR	PROPORTION	CEMENT	SAND
(i) cement mortar	1 : 2	0.60 cum	1.20 cum
(ii) cement mortar	1 : 3	0.45 cum	1.35 cum
(iii) cement mortar	1 : 4	0.40 cum	1.60 cum
(iv) cement mortar	1 : 5	0.35 cum	1.75 cum
(v) cement mortar	1 : 6	0.30 cum	1.80 cum
(vi) Kankar lime	1.80 cum(kankar lime)	
(vii) White lime and surkhi or sand	1 : 1	1.00 cum white lime, surkhi or sand	1.00 cum
(viii) white lime and surkhi or sand	1 : 2	0.70 cu m white lime, and surkhi or sand.	1.40 cu m
(ix) cement white lime and sand	1 : 1 : 6	0.30 cu m cement,0.30 cu m lime and 1.80 cu m sand.	
For 20mm thick plastering total dry volume 3cum.			
(i) cement mortar	1 : 2	1 : 00 cu m	2.00 cu m
(ii) cement mortar	1 : 3	0.78 cu m	2.34 cu m
(iv) cement mortar	1 : 5	0.54 cu m	2.70 cu m
(v) cement mortar	1 : 6	0.46 cu m	2.76 cu m

(6) CEMENT CONCRETE FLOOR :

The quantity of cement concrete may be calculated by multiplying the area of floor by the thickness and the quantity of each material may be found on the same principle as for cement concrete.

- (a) For 2.5 cm C.C floor for 100 sq.m of area the quantity of cement concrete = $100 \times 0.025 = 2.5$ cu m. Adding 10% extra for unevenness of base concrete the quantity comes to $2.5 + .25 = 2.75$ cu m. For 100 cu m cement concrete the total dry volume of materials is 125, i.e approximately 50% more.
- (b) For 2.5 cm thick CC floor of 1 : 2 : 4 proportion, for 100 sq m total dry volume of materials = $2.75 + 50\% = 2.75 + 1.375 = 4.125$ cu m.

$$\text{Therefore, cement} = \frac{4.125}{1+2+4} = \frac{4.125}{7} = .59 \text{ cu m} = .60 \text{ cu m.}$$

(18 bags), Sand = $0.6 \times 2 = 1.20$ cu m, and stone aggregate = $0.6 \times 4 = 2.40$ cu m. for neat cement surface finishing additional 0.2cu m (6 bags) of cement will be required.

- (c) For 2 cm thick C.C floor of $1:1\frac{1}{2}:3$ proportion for 100 sqm. the dry volume of materials as above is equal to 4.125 cu m.

$$\text{Therefore, cement} = \frac{4.125}{1+1\frac{1}{2}+3} = \frac{4.125}{5\frac{1}{2}} = .75 \text{ cu m} = 22.5 \text{ bags,}$$

Quantity of sand = $0.75 \times 1\frac{1}{2} = 1.125$ cum, and the Quantity of stone aggregate is equal to $0.75 \times 3 = 2.25$ cu m.

For neat cement finishing add extra cement of 0.2 cum.

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- (d) For 4 cm thick C.C 1 : 2 : 4 floor 100 sqm, total dry volume of concrete = $100 \times 0.04 \times 10\%$ (for unevenness) + 50% increase for dry volume = $4.4 + 2.2 = 6.6$ cu m.

Therefore, cement = $\frac{6.6}{1 \ 2 \ 4} = 0.94$ cum (28.2 bags),

Sand = $0.94 \times 2 = 1.88$ cu m and stone aggregate = $0.94 \times 4 = 3.76$ cu m, for neat cement finishing add extra cement of 0.2 cu m (6 bags).

- (e) For coloured cement floor, mix design pigment colour with neat surface cement in the proportion of 1 : 3 to 1 : 6 (colour : cement) to have the desired colour. White cement mixed with colour pigment of the desired proportion may also be used, but for strength, it is better if ordinary portland cement is mixed with white cement in the proportion of 1 : 1 to 1 : 3 (grey Portland cement, white cement) and then to add colour pigment to have the desired colour.

When colour pigment is mixed with white cement then the requirement to colour pigment is much less, may be 1 : 5 to 1 : 10 (pigment : white cement).

(7) CALCULATION OF MATERIALS FOR MOSAIC TERRAZO FLOOR FOR 100 sqm

20 mm thick C.C 1 : 2 : 4 - volume of C.C - $100 \times 0.02 \times 10\%$ for uneven and rough base = 2.00 to 0.20 = 2.20 cu m.

Dry volume = 2.2 to 50% = $2.2 + 1.1 = 3.3$ cu m.

cement $\frac{3.3}{1+2+4} = 0.47$ cu m (14.1 bags), Sand =

$0.47 \times 2 = 0.94$ cu m, stone chips = $0.47 \times 4 = 1.88$ cu m.

6 mm Mosaic layer $1:1\frac{1}{2}$ volume of mosaic concrete = $100 \times 0.006 \times + 20\%$ for surface cutting by rubbing = $0.60 + 0.12 = 0.72$ cu m. Dry volume = $0.72 + 50\% = 0.72 + 0.36 = 1.08$ cu m.

Cement = $\frac{1.08}{1+1\frac{1}{2}} = \frac{1.08}{2\frac{1}{2}} = 0.4$ cu m (12 bags), marble

chips = $0.4 \times 1\frac{1}{2} = 0.60$ cum.

Materials for mosaic layer for different proportion :

- (i) Proportion 1 : 1 - cement = 0.50 cum (15 bags), marble chips = 0.5 cum.

- (ii) Proportion $1:1\frac{1}{2}$ cement = 0.40 cum (12 bags), marble chips = 0.6 cum

- (iii) Proportion 1 : 2 = cement = 0.36 cum (10.8 bags), marble chips = 0.72 cum.

- (iv) To get whitish base (ground) 10% to 20% of marble dust may be mixed with Portland cement.

Mosaic Rado or skirting : 6 mm thick mosaic layer over 20mm thick cement plaster 1 : 3 cement : coarse sand. Materials for cement mortar are same as earlier. Similarly, materials for mosaic layer to be same as above.

labour may be increased by 10% over item.

Note: Marble chips are sold by weight - 1cum = 1650 kg = 16.5 quintal

Coloured mosaic floor:

- (i) Coloured marble chips may be mixed with white marble chips in the proportion required, usually in the proportion 3 : 1.3 parts of white chips and 1 part of black chips, shell chips or other coloured chips may also be mixed if so desired.

- (ii) Pure white cement, mixed with Portland cement in the proportion of 1 : 1 to 1 : 3 may be used to get white or partly white ground.

- (iii) Coloured ground for mosaic floor if required, white cement mixed with the required pigment colour 2 to 5 kg per bag of white cement should be mixed to have the desired colour. Coloured cement may also be used but it is very costly and normally used for high class work.

As white cement is costly, generally ordinary cement mixed with marble dust in the proportion of 3 of cement and 1 of dust is used, and to this mix of cement and marble dust pigment colour of the choice may be added to the required proportions to have the desired colour. For uniformity of colour, it is better if cement and colour are mixed at a time to meet the requirement of the floor of one room.

Tiles are usually supplied unground if ground tiles are supplied then labour for polishing may be reduced by 50% or 60 nos. Polisher may be required for polishing 100 sqm of floor. These are manufactured under press - machine under a pressure of 140kg per sq.m. The tiles may be of 20 x 20 cm or 30 x 30 cm nominal size, having actual size 19.85 x 19.85 cm or 29.85 x 29.85 cm. The mosaic layer consists of 6 mm thickness over a cement concrete bottom layer of 20mm to 25 mm thickness. The tiles are laid over 12mm to 20mm lime mortar (IS - 1443) over a sub base of lime concrete.

(8) SEPTIC TANK :

In rural areas in factories and in unsewered urban and semi-urban areas where adequate water supply is available from pipe, well or any other source, septic tank is suitable for disposal of night soil. Water is required for the flow of the night soil from latrine to the septic tank and for the functioning of septic tank. Septic tank and for the functioning of septic in the tank for 24 hours during which period certain biological

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decomposition by the action of anaerobic bacteria takes place. They breaks and liquifies the night soil leaving small quantity of solid which settles in the form of sludge at bottom of the tank and clear water flow out of the septic tank.

(i) Size of septic tank :

The capacity of the septic tank depends on the interval of sludge removal or cleaning. Normally sludge may be removed once in every two years and the liquid capacity of septic tank be taken as 0.13 cu m (130 litre) per head (5 cu ft per head) to 0.07 cu m (70 litre) per head (2.5 cuft per head).

Septic tank usually consists of brick wall in cement mortar not less than 20cm(9") thick and the foundation floor are of cement concrete 1 : 3 : 6 or 1 : 2 : 4. Both inside and outside face of wall and floor are plastered

with a minimum thickness of 12mm $\left(\frac{1}{2}''\right)$ thick cement mortar 1 : 3 and all inside corners are rounded. Floor should be given a slope of about 1 in 20 for the convenience of collection & removal of sludge.

Connecting pipe should be 100mm(4") minimum diameter and may be of S.W pipe, R.C.C or Hume pipe or cast iron pipe. Inlet or outlet may be made through T-Junction pipe. or baffle wall of precast. R.C.C may

be provided at a distance $\frac{1}{5}$ of length of the septic tank so that inlet content may not disturb the working of tank. Ventilation pipe of 50mm(2") minimum diameter are provided up to a height of 1.80 metre(6ft).

(ii) Design of septic tank for 25 users :

Liquid capacity of tank @ 0.1 cu m per users (100l per users) = $0.1 \times 25 = 2.50$ cu m

Taking liquid depth as 1.40 metre, the floor area of tank = $\frac{2.50}{1.40} = 1.80$ sqm.

Taking length as $2\frac{1}{4}$ times the breadth, $L \times B = 1.80$

sqm or $2\frac{1}{4}B \times B = 1.80$ m or $B^2 = \frac{1.80}{2\frac{1}{4}} = 0.80$, therefore

breadth 'B' = $\sqrt{0.8} = 0.9$ M

Therefore, the length of tank

$$= 2\frac{1}{4} \times 0.9 = 2.02 = 2.00\text{m}$$

Taking a free board of 30cm total depth of the tank = $1.40 + .30 = 1.70$ m.

Thus, a tank of 2.00 metres long \times 0.9 metre wide and 1.70 metre deep will serve the purpose.

METHODS AND UNITS OF MEASUREMENT :

(Based on Indian standard - IS : 1200)

Measurement of works occupies a very important place in the planning and execution of any work or project, from the time of the first estimate are made until the completion and settlement of payments. The method followed for the measurement are not uniform and the practices as prevalent differ considerably in between the states.

(1) General Rule:

- (i) Measurement shall be item wise for the finished item of work and the description of each item shall be held to include material, transport, labour, fabrication, hosting, tools and plants, overheads and other incidental charges for finishing the work to the required shape, size, design and specifications. The nomenclature of each item should be fully described so that the work involved in item is self explanatory.
- (ii) In booking dimensions, the order shall be in the sequence or length, breadth and height or depth or thickness.
- (iii) All work shall be measured net subject to following tolerances unless otherwise stated:-
 - (a) Dimensions shall be measured to the nearest 0.01 metre.
 - (b) Areas shall be measured to the nearest 0.01 sqm (0.1 sqm)
 - (c) Cubic contents shall be worked up to the nearest 0.01 cu m (0.1 cu ft).
- (iv) Same type of work under different conditions and nature shall be measured separately under separate item.
- (v) The bill of quantities shall fully describe the materials, proportions and workmanships and accurately represent the work to be executed. Work which by its nature can't be accurately taken off or which requires site measurements, shall be described as provisional,
- (vi) In case of structural concrete, brickwork or stone masonry, the work under the following categories shall be measured separately and the heights shall be described:-
 - (a) From foundation to plinth level,(b) from Plinth level to first floor level,(c) From first floor level to second floor level and so on.

Principle of units :

The units of different works depend on their nature, size and shape. In general the unit of different items of work are based on the following principle:-

- (i) mass, with more volume, and thick works shall be taken in cubic unit or volume. The measurement of length, breadth and height or depth shall be taken to compute the volume or cubic contents (cu m)
- (ii) Shallow, thin and surface work shall be taken in square unit or in area. The measurement of

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- length and breadth or height shall be taken to compute the area (sq.m)
- (iii) Long and thin work shall be taken in linear or running unit, and linear measurement shall be taken(running metre).
- (iv) Piece work, job work, etc. shall be enumerated, i.e, taken in number.

EARTHWORK

- (i) Earthwork shall be taken in cu m (cu ft) and the length breadth and height or depth shall be measured to get the cubic content.
- (ii) Earthwork of different nature as in excavation in foundation, in trenches etc and in filling plinth, in banking etc. has to be measured under seperate items,
- (iii) Earthwork in different kinds of soil, hard soil, ordinary rock, hard rock etc shall be classified separately and measured under seperate item.
- (iv) Excavation shall include throwing of the excavated earth at least one metre clear of the edge of excavation.
- (v) Dressing or trimming and levelling or grading, ramming and consolidation, thickness of each layer, etc, shall be described and included in the item of earthwork.
- (vi) Measurement of excavation or trenches or borrowing pits shall be taken for average dimensions. When ground is fairly uniform "Deadman" or Tell - Tales" which shall be left at suitable intervals to determine the average depth or excavation. For uneven or sloping ground diagonal " Tell - Tales" shall be left.
- (vii) No deduction shall be made for deadmen, Tell-Tales which shall be removed after the measurement have to be taken and checking completed.
- (viii) when the ground is very uneven levels before the start and after the completion of the earthwork by levelling instrument and the average depth or excavation or filling shall be determined from these levels, higher and lower levels.
- (ix) Whenever it is not possible or convenient to make measurements from cutting, the filling or banking shall be measured and deduction for shrinkage or voids shall be made from actual measured cubic content depending on the nature of soil and method of consolidation. Generally 10% deduction shall be made in case of ordinary consolidated fills and in case of consolidation done by heavy machinery, a deduction of 5% shall be made.
- (X) For road earthwork in banking, the profile or fill measurement will be taken and usual settlement or shrinkage allowance shall be

given. The volume or quantity shall be obtained from multiplying sectional area by length.

$$\text{Quantity} = \text{Length} \times \frac{1}{2}(\text{Top length} + \text{Bottom width}) \times \text{Height.}$$

No seperate measurement shall be taken. For setting out works, profiles, site clearance, deadmen, stepping, removal of slips or falls, bailing out water from rains,etc. are also to be included in the rate.

lead and lift : The measurement shall be taken separately for every 30m (100ft) head or distance and every 1.5m (5ft) lift or height or depth. The lead shall be measured from the centre of the area of excavation to the centre of the area of spoil heap. Similarly lift shall be measured from the centre of excavation to the centre of spoil heap.

The normal rate is for each unit of 30m (100') lead and 1.5m (5') lift. For greater lead or lift the rate shall be different for every unit of 30m (100ft) lead and for every unit of 1.5m (5ft) lift.

I.S.I specifies the unit of lead as 50m,measured over the shortest practicable route.

Foundation trench : Unless otherwise specified, the foundation trench shall be measured in cum for rectangular section, bottom width being width of concrete and the depth shall be measured as vertical depth even though the contractor might have excavated with sloping sides for convenience.

Return fill and ram : Returing, filling and ramming excavated earth shall be taken in cu m (cu ft) under a seperate item and shall include spreading in layers of 20cm (8") in depth, watering, ramming and levelling.

Pudding : Clay puddle work shall be taken in cu m (cu ft) and shall be described including supply of clay, its preperation and placement in layer of 15cm(6") ramming etc.

Surface dressing : Trimming and dressing of natural ground to remove vegetation and small irregularities not exceeding 15cm(6") deep shall be taken in sq m (sq ft) under a seperate item surface dressing. The cutting down trees exceeding 30cm (12") girth shall be accounted seperately and enumerated,i.e taken in numbers stating the girth at 1m (3') above ground and paid separately.

Surface excavation : Excavation exceeding 1.5m in width as well as 10sq m in plan but not exceeding 30cm in depth shall be described as surface excavation and measured in sq.m

Pumping : When stream water requires pumping or dewatering shall be taken under a seperate item.

Timbering : Timbering or "planking and strutting" for protecting the sides of trench or loose earth, shall be measured in sq m of face supported and shall be classified under separate items as :-

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- (a) Depth not exceeding 1.5m,(b) Depth exceeding 1.5m but not exceeding 5m,(c) Depth exceeding 5m.

Timbering shall include all the necessary timber work including walls, struts, polling boards, etc. Both sides of trench shall be taken as one side area and shall be equal to length × depth of timbering.

CONCRETE

For concrete kind, size, grading and proportion of materials method of mixing, cutting, etc, have to be described. Different kinds of concrete work as lime concrete, cement concrete, Reinforced cement concrete,etc, of different proportions, different materials shall be taken under separate items Concrete foundation, roof, wall, mass concrete, etc. shall be classified and measured under separate items.

Concrete shall be taken in cu m (cu ft) and measurement of length, breadth and height or thickness shall be taken to the nearest $0.5\text{cm} \left(\frac{1}{4}\right)$. No deduction shall be made for opening up to 0.1 sqm (1sq .ft).

Formwork, centering and shuttering shall be taken under separate item in sqm(sq ft) unless otherwise therein provided. Formwork shall be measured as the actual surface in contact with the concrete. For slabs vertical sides (edges) are not to be measured.

Flair finish to the exposed surface of concrete or hacking or roughening surfaces of concrete shall be included in the description and the thickness of finishing shall not be measured with the concrete. Special finishes, except in precast concrete shall be measured separately in sqm.

R.C.C. Work: Reinforced cement concrete shall be kept separate from unreinforced concrete .R.C.C work shall be taken in cu m (cu ft) excluding steel and the steel reinforcement shall be measured under a separate item in quintal (cwt) authorised overlaps hooks, cranks, etc of bars shall be measured. normally, centering and shuttering (formwork) shall not be measured separately included in the rate of R.C.C or C.C work. Binding work is not measured separately. The volume occupied by reinforcement shall not be deducted from the measured concrete volume. The item of R.C.C work shall include R.C.C slabs, beams, lintels, columns, chujjas, staircases, foundation, rafts and footing etc. and each of them shall be classified under a separate item. The expose surface shall be fair finished which shall not be measured separately chujjas may be measured in running metre stating the projection and its average thickness, if specified.

Special light weight partitions shall be measured in sqm stating thickness and fully described.

- (i) **Precast cement concrete :** Precast C.C reinforced or plain shall be taken separately in cu m (cu ft) and shall be described as including all moulds, finished faces hoisting and setting in positions. Reinforcement if any shall be described and included in the item or measured separate if specified.
- (ii) **Expansion joint :** Expansion joints in roofs, Floors, walls, road etc. Shall be measured in running metre (r ft) the depth and width of joint and materials used for filling shall be described.
- (iii) **Joints :** Jallies or jaffries, lowers shall be described and thickness specified and taken in sqm (sq ft). Reinforcement shall be described and included in the item.
- (iv) **Concrete posts :** Fencing posts, corner posts, struts etc. Shall be taken in cu m and reinforcement and form work shall be included and described.
- (v) **Concrete piles :** Concrete piles shall be described and taken in cum (cu ft) and classified according to the section and the length. Steel reinforcement shall be included with the item and fully described. Head and shoes of steel or iron shall be enumerated. I.e taken in numbers and weight of each stated. Pitching and driving of piles shall be enumerated stating size and length. If specified, the driving of piles may be taken and measured in running metre for the portion driven below ground level.
- (vi) **Damp proof course :** Damp proof course shall be fully described and taken in sqm(sq.ft) stating the thickness. The item shall include formwork finishing, levelling, curing, etc. The horizontal and vertical damp proof courses shall be measured separately.

BRICKWORK

The description of the bricks and of the materials of mortar with proportion shall be stated. Different kinds and classes of brickwork shall be taken under separate items. The brickwork of foundation and plinth of first floor, of second floor, etc. It shall be measured under separate items. Scaffolding works are not measured separately but included in the item of brickwork.

Brickwork shall be taken in cu m (cu ft), and measurements of length, breadth or thickness and height shall be taken to compute the quantity. The length and height shall be measured to the nearest 1

cm $\left(\frac{1}{2}\text{"}\right)$.

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(i) **Thickness of wall :** Bricks walls upto and including bricks in thickness shall be measured in multiples of half brick, which shall be deemed to be inclusive of the mortar joint. The following shall be taken as brick measurement:

(a) For brick nominal size $22.9 \times 11.4 \times 7.6$ cm

$(9'' \times 4\frac{1}{2}'' \times 3'')$ Half brick size is 11.4 cm ($4\frac{1}{2}''$) .

(b) For brick nominal size $22.5 \times 12.7 \times 7.6$ cm($10'' \times 5'' \times 3'$) Half brick size is 12.7 cm($5''$).

(c) For module bricks 20 cm $\times 10$ cm $\times 10$ cm (actual size $19cm \times 9cm \times 9cm$), Half brick size in 10 cm.

(d) Thus for different bricks $20cm \times 10 \times 10$ cm

$(9'' \times 4\frac{1}{2}'' \times 3'')$

(e) One brick wall shall be measured as 20 cm one and half brick wall as 30 cm and two brick wall as 40 cm etc.

However, for walls which are more than three bricks in thickness, the actual thickness shall be

measured to the nearest $1cm$ $\left(\frac{1}{2}''\right)$.

Here functions of half brick occur due to architectural or other reasons the measurements shall be taken as follows:-

(a) For fractions of $2cm$ under actual measurement.
(b) For fractions exceeding $2cm$ -full half brick.

(ii) **Deduction:** No deduction or addition shall be made for the following:-

(a) Opening upto 0.1 sq m ($1sq ft$) in section.
(b) Ends of joints, beams, lintels, posts, rafters, purlins, corbels, steps, etc.
(c) Wall plates and bed plates, bearing of slabs, chajjas, and the like where the thickness does not exceed $10cm$ and the bearing does not extend over the full width of wall.

WOODWORK

(i) **Carpenter's work :** Generally all woodwork of which the scantling exceeds 20 sq cm (3 sq in) in section and which is not specially moulded or carved comes under carpenter's work. This includes all times work in door and windows chaukhats, in roof works as beams strutsies rafters, purlins (all work in roof trusses), in timber bridge in verandah posts, in centering and shuttering in shoring and the like.

(ii) **Joinery :** Woodwork which is prepared, turned, moulded, carved and jointed together comes under joinery. Joiner's work requires finishing and

putting together at the bench and includes door and window shutters, framed partitions, furnitures and the like.

CLASSIFICATION OF TIMBER :

- (a) **Batten :** Battens are pieces of sawn timber, whose dimensions do not exceed $5cm(2")$ either in breadth or in thickness.
- (b) **Scantlings :** Scantlings are pieces of sawn timber whose cross-sectional dimensions exceed $5cm(2")$ in both directions and do not exceed $20cm(8")$ in both direction.
- (c) **Baulks :** Baulks are pieces of sawn timber whose cross-sectional dimensions exceed $5cm(2")$ in one direction and $20cm(8")$ in other direction.
- (d) **Planks :** Planks are pieces of sawn timber whose thickness does not exceed $5cm(2")$ and at the same time the width exceeds twice and the thickness.

Centring and shuttering : Normally centring and shuttering (formwork)shall not be measured separately but included in the rate of C.C or R.C.C work. It is specified that the formwork shall be paid separately. The formwork shall be measured the actual surface in contact with the concrete shall be taken in sq m (sq ft) and include planking beams, props, wedges, nails etc.

Formwork of different kind of works as beams, lintels, floors, roads, walls, columns, staircases etc. shall be measured under seperate items and fully described.

For slabs,chajjas, arches, shells and domes only the area of bottom shuttering in contact with concrete surface shall be measured and side shuttering shall not be taken into account.

STEEL AND IRON WORK

In general steel and iron work shall be measured by weight in quintal (cwt) and fully described. Various items of rolled steel sections as joints, channels, angles, tees, mild steel rounds, flats, bolts, cast iron or wrought iron, shall be measured under separate item.

Steel reinforcement : Bar reinforcement shall be measured cutting the length, hooked ends, cranking or bending etc.

Authorised overlaps shall be measured. Different diameters bars shall be kept separate.

Binding wire shall not be measured separately, this shall be included in the item.

Fabric reinforcement shall be taken in sq m (sq ft) stating the mesh and size of strands.

Wire netting in wrappings to steel work embedded in concrete or plaster, in encasing steel work shall be measured separately in sq m (sq ft) stating the mesh and gauge.

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Hoop iron shall be measured in running metre (r ft) stating the width and gauge.

Wire fencing : Plain or barbed wire in fencing shall be measured in running metre (r ft) and shall be described stating the gauge. Each line of wire shall be measured. Fencing posts shall be measured separately.

Steel doors and windows shall be taken in sq m (sq ft) stating the size of various numbers and shall be described. Hanging, fixing and fastening in position shall be included and described including the method of fixing.

PLASTERING AND POINTING

Plastering : Plastering shall be taken in sq.m (sq ft) stating thickness, mortar and its mix plastering of roofs ceiling, walls etc. shall be measured under separate items. The measurement of all plastering shall be taken for the dimensions before plastering for length and from top to floor or skirting to the ceiling for height. Exterior plastering to a height greater than 10m(30ft) from average ground level shall be measured separately in stages of 3m(10ft).

Plastering bands 30cm(12") or below shall be measured in running meter(r ft).

Deduction :

- (a) No deductions shall be made for ends of joint, beams posts etc. and opening not exceeding 0.5 sqm(5 sq ft) each and no addition shall be made for reveals, jambs, soffits, sills etc., Of these openings there is no finishing plaster around ends of joints, beams, posts etc.
- (b) For opening exceeding 0.5 sq m (5 sq ft) but not exceeding 3 sq m(30 sq ft) each deduction shall be made for one face only and other face shall be allowed for jambs, soffits and sills which shall not be measured.
- (c) When the two faces are plastered with different mortars, or if one side is plastered the other pointed deduction shall be made on the side of chukhat of door and windows on which the width of jamps or reveals is less than on the side (usually, deduction shall be made for the outer face only).
- (d) In case of opening of area above 3 sq m (30 sq ft) each deduction shall be made for both faces of the openings and the jambs and sills, shall be measured and added. In taking measurement of jambs, soffits and sills, chukhat if any shall be neglected and the whole shall be measured.

Moulded cornices and cues, shall be measured in running metre (r ft) stating the girth and shall be described fully.

POINTING : Pointing shall be taken in sq m(sq ft) and measured flat for the whole surface area stating the type of pointing mortar and its mix. Various types of pointing as struck flush, keyed, truck etc shall be taken separately. Pointing wall, floor, roof etc shall be kept separate. Ranking of joints shall be included in the item.

Deduction shall be dealt in the same way as for plastering.

PAINTING

Painting shall be taken in sq m (sq ft) stating number of coats and measurement shall be taken flat. Preparatory work as cleaning, rubbing down, removing, burning off etc. shall be described.

Different types of surfaces as steel, wood, fibre board, concrete surface etc. shall be measured under separate item. The painting in large area as roof ceiling etc. shall be kept separate and painting of small areas as doors and windows, steel works etc, shall each be taken under separate item.

Corrugated surfaces shall be measured flat in sq m (sq ft) and percentage increase similar to white washing etc. shall be added.

Doors and windows : Painting of doors and windows shall be measured as closed and flat not girthed in sq m (sq ft). It shall include chauhat edges, cleats etc. Different types of doors and windows as battened, panelled, glazed, etc. shall be grouped under one item and the areas of uneven surface shall be covered into equivalent plain area by multiplying the flat measured area by a multiplying factor.

SANITARY AND WATER SUPPLY WORKS

All pipes and fitting should be classified according to their type, diameters, jointing and fixing pipes of different types joints which shall be taken separately. The diameter shall be the nominal diameter of the internal bore.

Pipes shall be measured in running metre (r ft) net as laid or fixed with overall fitting such as bends, junction etc, shall not measured separately. The length shall be measured along the centre line of the pipes and fitting. Methods of laying and jointing shall be fully described. Testing of pipe line shall be included in the item. Lead caulked joints shall be enumerated separately.

Digging and refilling of trenches, concrete bedding etc. shall be either measured separately or clubbed with the main item.

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Usually for small diameter pipes, the digging and refilling timbering if required, concrete bedding etc. are included with the main item and fully described.

(i) **Fitting and appliances :** Gullies, siphons, intercepting traps, etc. including concrete bedding and setting in position shall be enumerated stating the size. Connection of fitting, elbows, bends, tees, connectors, diminishing sockets and the like shall also be enumerated.

Cutting through walls, floors, etc, and making good shall be included with the item. Closet pans, urinals, flushing cisterns, lavarotary basins, bath tubs, shower hose and other fitting shall be enumerated stating the size and fully described.

Bib-cocks, pillar cocks, ball cocks, ferrules, gratings etc shall be described stating the size and enumerated.

Boilers, cisterns, cylinders , water tanks etc. shall be enumerated stating the size capacity materials, etc, and fully described.

(ii) **Manholes :** Manholes of upto 6m (20ft) depths shall be enumerated stating the size and depth and shall include cost of iron cover with frame (weight to be stated) foot iron, invert, materials and mortar, formwork etc all of which shall be fully described. Manholes shall be classified under three different groups as follows:-

- (a) Shallow: Up to 2.1m (7') in depth
- (b) Deep: above 2.1m & (7' to 14') upto 7.2m in depth
- (c) Extra deep : above 4.2m & (14' to 20') upto 6.0m in depth.

Manholes under each classification shall be enumerated separately stating the size and least depth and the extra depth shall be measured in running metre (r ft) and totalled up separately for each classification and taken as " extra over under separate item following the main item. Depth shall be from the top of manhole to the invert of channel.

Manholes exceeding 6m(20') in depths shall be measured in details under the various items of works i.e. brickwork, concrete, C.I cover with frame etc.

CENTRE LINE METHOD:

In this method sum-total length of centre lines of walls, long and short, has to be found out. It also involves finding the total length of centre lines of walls of same type, long and short having same type of foundations and footing and then find the quantities by multiplying the total centre length by the respective breadth and height. In this method, the length will remain same for excavation in foundation for concrete in foundation, for all footings and for superstructure .This method is quick but requires special attention

and consideration at the junctions, meeting points of partition or cross walls, etc.

For rectangular, circular polygonal (hexagonal, octagonal) building having no inter or cross walls, this method is quite simple. For buildings having cross or partition walls, for every junction of partition or cross walls with main walls/Special consideration shall have to be made to find the correct quantity. For each junction half breadth of the respective item or footing is to be deducted from the total centre length. Thus, in case of building with one partition wall or cross wall having two junctions, for earthwork in foundation trench and foundation concrete deduct one breadth of trench or concrete from the total length (half breadth

for one junction and one breadth $2 \times \frac{1}{2} =$ one for two junction). For footing similary deduct one breadth of footing for two junctions from the total centre length and so on.

If two walls comes from opposite directions and meet the wall at the same point, then there will be two junctions.

For building having different type of walls, each set of walls shall have to be dealt separately. Find the total centre length of all walls of one type and proceed in the same manner as described above. Similarly find the total centre length of walls of second type and deal separately and so on.

In case of building having different types of walls,suppose the outer (main) walls are of A type and inter cross walls are of 'B' type, then all 'A' type walls shall be taken jointly first and then all B type walls, but when 'B' type walls are taken, for each junction deduction of half breadth of 'A' type wall (main wall) shall have to be made from the total centre length of walls.

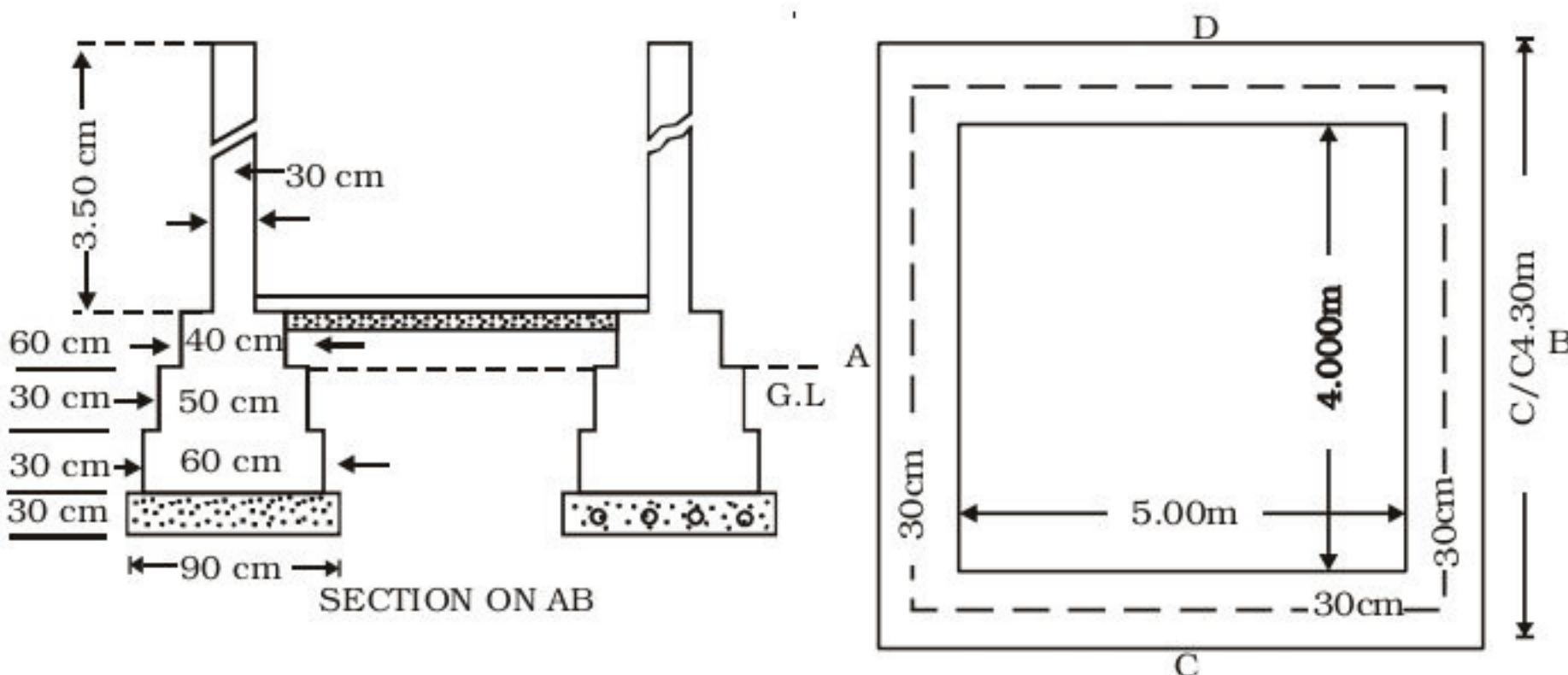
It may be noted that at corners of the building where two walls are meeting no subtraction or addition is required.

When there are number of footings, the length of the first footing is to be determined by deducting half breadth of footing per junction from the total centre line length and then the length of the subsequent footing can be obtained simply by adding one offset of footing i.e., 5cm for every junction to the length of the previous footing.

Eg:1:-Estimate by centre line method the quantities of the following items of a single room building of a given figure.

- (i) Earthwork in excavation in foundation,
- (ii) Concrete in foundation
- (iii) Brickwork in foundation and plinth, and
- (iv) Brickwork in superstructure.

ESTIMATING AND COSTING



PLAN OF SUPERSTRUCTURE WALL

Figure :-1

Solution:- Total Centre length of walls = AB + BC + CD + DA = 5.30 + 4.30 + 5.30 + 4.30 = 19.20m.

If the total centre length is multiplied by the breadth and depth we get the quantity of earthwork in excavation. By doing so we take certain portion twice and leave an equal portion but this does not affect the quantity.

The quantity of excavation = AB × 90cm × 90cm + BC × 90cm × 90 cm + CD × 90cm × 90cm+ DA × 90cm × 90cm.

DETAILS OF MEASURMENT AND CALCULATION OF QUANTITIES

Item No	Description of items	No.	Length	Breadth	Height or Depth	Quantity notes	Explanatory
1	Earthwork in excavation in foundation	1	19.20	.90m	.90m	15.55 cum	Total centre length of all walls = 19.20m
2	Concrete in foundation	1	19.20	.90	.30m	5.18 cum	
3	Brickwork in foundation and plinth. 1st footing 2nd footing ... Plinth wall ...	1 1 1	19.20m 19.20m 19.20m	.60m .50m .40m	.30m .30m .60m	3.46 2.88 4.61 Total 10.95 cu m	
4	Brickwork in super structure	1	19.20m	.30m	3.50m	20.16 cum	Door & windows opening lintels etc to be deducted.

MID-SECTION METHOD :

Mid-Section formula is used to calculate volume of earthwork by averaging the depth of two consecutive sections, mean depth is calculated first and from the mean depth, the area of mean section is calculated and finally volume of earthwork is computed by multiplying the area of mid-section by the distance between the two original sections.

Volume of earthwork = Area of mid section × Distance between two consecutive sections.

TRAPEZOIDAL METHOD :

This method assumed that mid area of pyramid is

half the average area of the end sections and the end sections are in parallel planes.

A_1 and A_2 are the areas of the end sections and 'L' is the length between two sections then the earthwork is given by:-

$$V = A_m \times L$$

Where, A_m = Mean sectional area

$$A_m = \frac{(A_1 + A_2)}{2}$$

$$\text{Therefore, } V = \frac{L(A_1 + A_2)}{2}$$

