Quantity surveying

INTRODUCTION

1.1 DEFINITION OF ESTIMATING AND COSTING

Estimating is the technique of calculating or Computing the various quantities and the expected Expenditure to be incurred on a particular work or project. In case the funds available are less than the estimated cost the work is done in part or by reducing it or specifications are altered, the following requirement are necessary for preparing an estimate.

a) Drawings like plan, elevation and sections of important points.
b) Detailed specifications about work men ship & properties of materials etc.
c) Standard schedule of rates of the current year.

1.2 NEED FOR ESTIMATION AND COSTING

1. Estimate give an idea of the cost of the work and hence its feasibility can be determined i..e whether the project could be taken up with in the funds available or not.
2. Estimate gives an idea of time required for the completion of the work.
3. Estimate is required to invite the tenders and quantities and to arrange contract.
4. Estimate is also required to control the expenditure during the execution of work.
5. Estimate decides whether the proposed plan matches the funds available or not.

1.3 PROCEDURE OF ESTIMATING OR METHOD OF ESTIMATING.

Estimating involves the following operations

1. Preparing detailed Estimate.
2. Calculating the rate of each unit of work
3. Preparing abstract of estimate

1.4 DATA REQUIRED TO PREPARE AN ESTIMATE

1. Drawings i.e. plans, elevations, sections etc.
2. Specifications.
3. Rates.

1.4.1 DRAWINGS

If the drawings are not clear and without complete dimensions the preparation of estimation become very difficult. So, It is very essential before preparing an estimate.

1.4.2. SPECIFICATIONS

a) General Specifications: This gives the nature, quality, class and work and materials in general terms to be used in various parts of wok. It helps no form a general idea of building.

b) Detailed Specifications: These gives the detailed description of the various items of work laying down the Quantities and qualities of materials, their proportions, the method of preparation workmanship and execution of work.

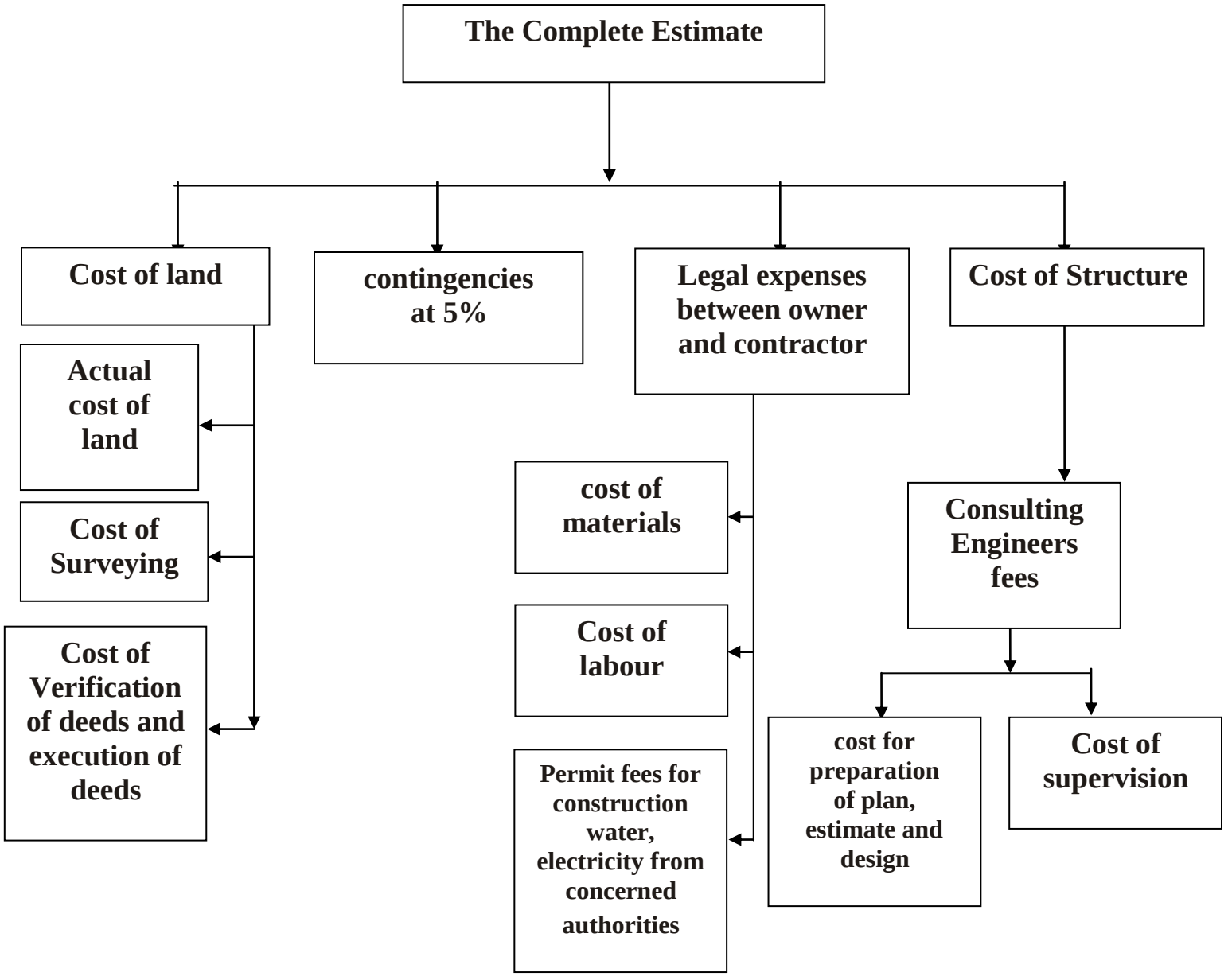
1.4.3. RATES:

For preparing the estimate the unit rates of each item of work are required.

1. For arriving at the unit rates of each item.
2. The rates of various materials to be used in the construction.
3. The cost of transport materials.
4. The wages of labour, skilled or unskilled of masons, carpenters, etc.,

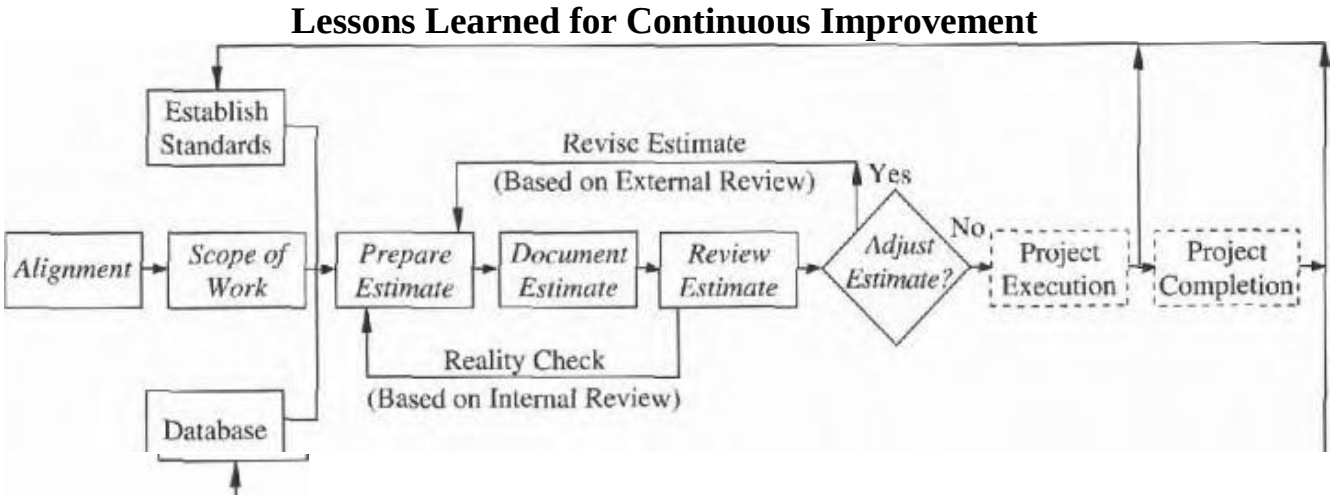
1.5 COMPLETE ESTIMATE:

Most of people think that the estimate of a structure includes cost of land, cost of materials and labour, But many other direct and indirect costs included and is shown below.



APPROXIMATE ESTIMATE:

Preliminary or approximate estimate or abstract estimate is required for studies of various aspects of work of project and for its administrative approval. It can decide, in case of commercial projects, whether the net income earned justifies the amount invested or not. The approximate estimate is prepared from the practical knowledge and cost of similar works. The estimate is accompanied by a report dually explaining necessity and utility of the project and with a site or layout plan. A percentage 5 to 10% is allowed for contingencies. The work process of early estimate show in figure below:



Estimate Feed-Back for **Continuous improvement**

FIGURE

Estimating **Work Process**

The following are the methods used for preparation of approximate estimates.

a) Plinth area method

b) Cubical contents methods

c) Unit base method.

a) Plinth area method: The cost of construction is determined by multiplying plinth area with plinth area rate. The area is obtained by multiplying length and breadth (outer dimensions of building). In fixing the plinth area rate, careful observation and necessary enquiries are made in respect of quality and quantity aspect of materials and labour, type of foundation, high of building, roof, wood work, fixtures, number of storey etc., the following areas include while calculating the plinth area of building.

a) Area of walls at floor level.

b) Internal shafts of sanitary installations not exceeding 2.0m2, lifts, air-conditioning ducts etc.,

c) Area of barsati at terrace level:

Barsati means any covered space open on one side constructed on one side constructed on terraced roof which is used as shelter during rainy season.
d) Porches of non cantilever type.

Areas which are not to include
a) Area of lofts.
b) Unenclosed balconies.
c) Architectural bands, cornices etc.,
d) Domes, towers projecting above terrace level.
e) Box louvers and vertical sun breakers.

The plinth area estimate is accompanied by:

1- Report.
2- Line plan of the building.
3- Brief specifications.
4- Line plan of building for which the plinth area rate is considered.

Example 1: Prepare an approximate estimate of building project with total plinth area of all building is 800 sqm. and from following data.
i) Plinth area rate. 4500 $ per sqm
ii) Cost of water supply @7½%of cost of building.
iii) Cost of Sanitary and Electrical installations each @ 7½% of cost of building.
iv) Cost of architectural features @1% of building cost.
v) Cost of roads and lawns @5% of building cost.
vi) Cost of supervision charges and contingencies @4% of total building cost.
Determine the total cost of building project.
Solution :

Example.2 : The plinth area of an approximate is 500 sqm. Determine the total cost of building from the following data:
a) Rate of construction = $.1230/--per sqm.
b) The height of apartment = 16.25 m
c) Water Supply, Sanitary and Electrical installations each at 6% of building cost.
d) Architectural appearance @ 1% of building cost.
e) Unforeseen item @2% of Building cost.
f supervision charges and contingencies @4% of total building cost.
Solution :

Example 3 : Prepare an approximate Estimate of a proposed building from the following?

Plinth area of the building = 226 sqm.
Cost of the structure = 2500 per sqm.
Water supply and sanitary arrangements = 12½%
Electrification =7%
Fluctuation of rates = 5%
petty supervision charges = 3%
sol:
Cost of Building = 226x 2500 = $.5,65,000

b) Cubical Contents Method: This method is generally used for multistoried buildings. The cost of a structure is calculated approximately as the total cubical contents (Volume of buildings) multiplied by Local Cubic Rate. The volume of building is obtained by Length x breadth x depth or height. The length and breadth are measured out to out of walls excluding the plinth off set and the height is taken from the top of the floor level to the top of the flat roof or half way of the sloped roof.. The cost of building= volume of buildings x rate/ unit volume. The Cubical area estimate is accompanied by:

1- Report.
2- Line plan of the building.
3- Brief specifications.
4- Line plan of building for which the plinth area rate is considered.

c) Unit Base Method: According to this method the cost of structure is determined by multiplying the total number of units with unit rate of each item. In case schools and colleges, the unit considered to be as 'one student' and in case of hospital, the unit is 'one bed'. the unit rate is calculated by dividing the actual expenditure incurred or cost of similar building in the nearby locality by the number of units.

Example 4: Prepare an approximate Estimate of a proposed building from the following?
Plinth Area = 500m2/floor
Ht of each storey = 3.5m
No.of storeys = G+2
Cubical content rate = $ 1000/m3
Provided for a following as a percentage of structured cost
a) water supply & Sanitary arrangement -8%
b) Electrification -6%
c) Fluctuation of rates - 5%
d) Contractors profit - 10%
e) Petty supervision & contingencies - 3%

Example 5: Prepare an approximate estimate or rough cost estimate of a hospital building for 50 beds. The cost of construction altogether for each bed is $. 60,000/-. Determine the total cost of hospital building.
Solution:

Example 6: To prepare the rough cost estimate of a hostel building which accommodate 150 students. The cost of construction including all provisions is $. 15,000/- per student. Determine total cost of building.
Solution :

EXERCISE
I. SHORT ANSWER QUESTIONS:
1. List the factors to be consider while preparing approximate estimate and explain briefly?
2. What are the differences between plinth area method and Unit base method?
3. List the requirements of data preparation.
II ESSAY TYPE QUESTIONS :
1. Prepare the approximate cost of building project (group Housing)
i) No.of houses = 150
ii) Plinth area of each dwelling = 600m2
iii) Plinth area rate = Rs. 5,000/-per m2
iv) Cost of water supply & sanitary arrangements @12½%
v) Electrification at 7½% of cost of building.
vi Cost of roads & Lawns @5%
vii) Cost of P.S.& contingencies @4%

2. Prepare a rough cost estimate of a cinema theatre which accommodate 1700 seats. The cost of construction including all provisions is $.6000/- per seat.

3. What are the methods of preparation of approximate estimates and explain briefly.

EARTH WORK
CALCULATIONS

Introduction:-

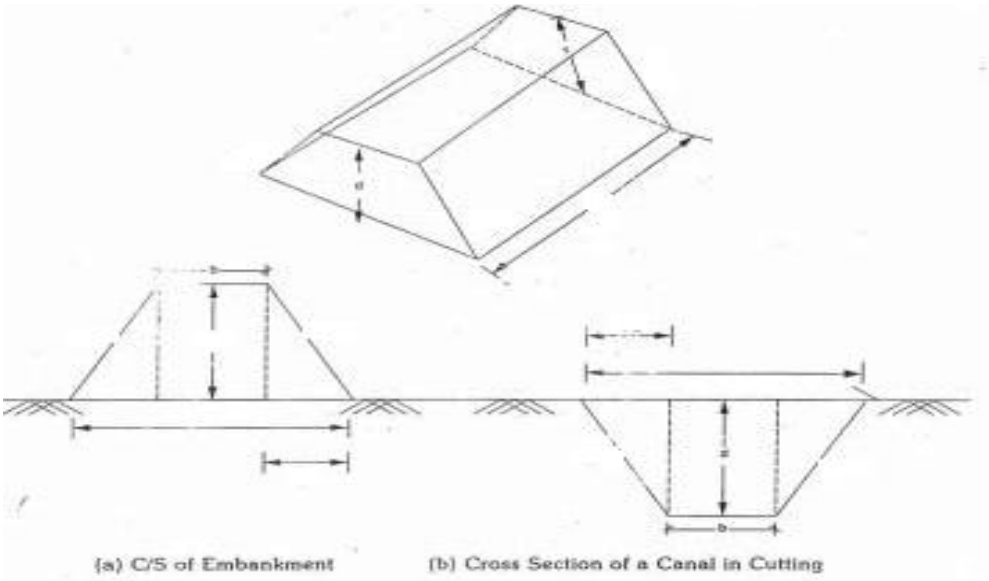
Generally all the Civil Engineering projects like roads, railways, earth dams, canal, buildings etc. involves the earth work. This earth work may be either earth excavation or earth filling or Sometimes both will get according to the desired shape and level. Basically the volume of earthwork is computed from length, breadth, and depth of excavation or filling. The various methods of calculating the earth work quantities shall be discussed.

Calculation of earth work for Roads:

case 1) volume of earth work in banking or in cutting having "no longitudinal slope .

*Quantity or volume = Sectional area * length.

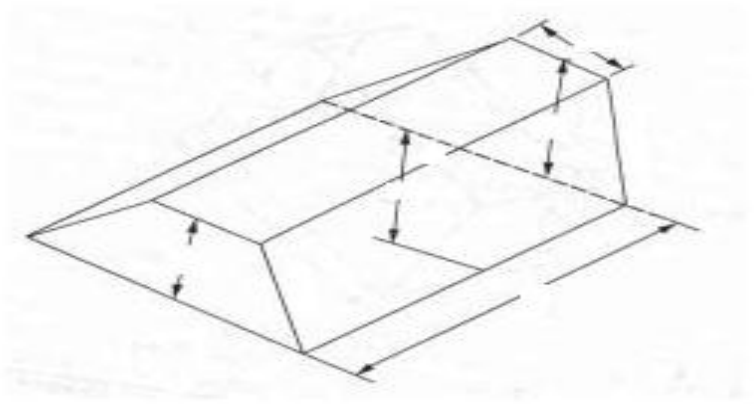
Cross section of earth work of road or canul in banking or in cutting is usually in the form of trapezoidal



V = (bd+nd2)L

Case 2:
When the ground is in longitudinal slope or the formation has uniform gradient for a length the earth work may be calculated by the following methods.

1. By Mid Section or Mid ordinate method.



Where d1, d2 = depth of banks at two ends
Mid ordinate (or) Average depth (dm) = d1+d2 / 2
Area of mid section (Am) = (bd+n(dm^2)
volume of earth work (v) = L/+6 ($A_1 + 4A_m + A_2$

ii) Trepezoidal formula: (for two sections) In this method also called mean sectional area method.
Let A1 &A2 be two areas at two ends.

$A_1 = (bd_1 + nd_1^2)$

$A_2 = (bd_2 + nd_2^2)$

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

Volume of earth work (v) = Am ×L

iii) Trepezoidal formula for a series of c/s areas at equal intervals.
Let A1,A2,A3.....An are the cross sectional areas along L.S of Road
'L" is the distance between two cross sections
The volume of earth work

$$V = \mathrm{L}\left\{\left(\frac{\mathrm{A}_1 + \mathrm{A}_\mathrm{n}}{2}\right) + A_2 + A_3 + ----A_{n-1}\right\}$$

$$V = \frac{\mathrm{L}}{2}\{(\mathrm{A}_1 + A_n) + 2(A_2 + A_3 + ----A_{n-1})\}$$

v = length /2 [(sum of first and last areas) + 2(reaming Areas)]

iv) Prismoidal formula for a series of cross sectional areas at equal intervals. Note : This method is adopted when there is odd number of cross sections.
Volume of earth work

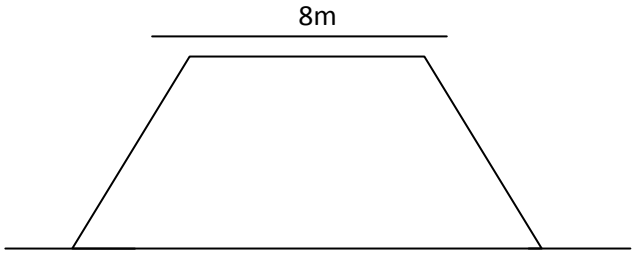
$$V = \frac{L}{3}\,(A_1 + A_n + 2\sum A_o + 4\sum A_e$$

V= length/3[(Sum of first and last areas)+4(even areas)+2(odd Areas)]

iii) Trepezoidal formula for a series of c/s areas at unequal intervals.
Let A1,A2,A3.....An are the cross sectional areas along L.S of Road
'L1,L2,L3,----------Ln" is the distance between two cross sections
The volume of earth work

$$V = \frac{(A_1 + A_2)L_1}{2} + \frac{(A_2 + A_3)L_2}{2} \pm ------\frac{(A_{n-1} + A_n)L_{n-1}}{2}$$

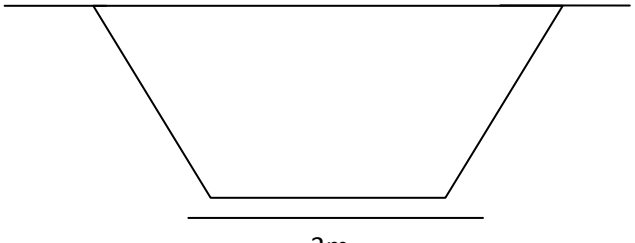
Example 1:- Estimate the quantities of earth work to road its length 100Km & width 8m slop 1:2 the high at the beginning of the road is 1m at the end 1.6m , its section as show bellow:



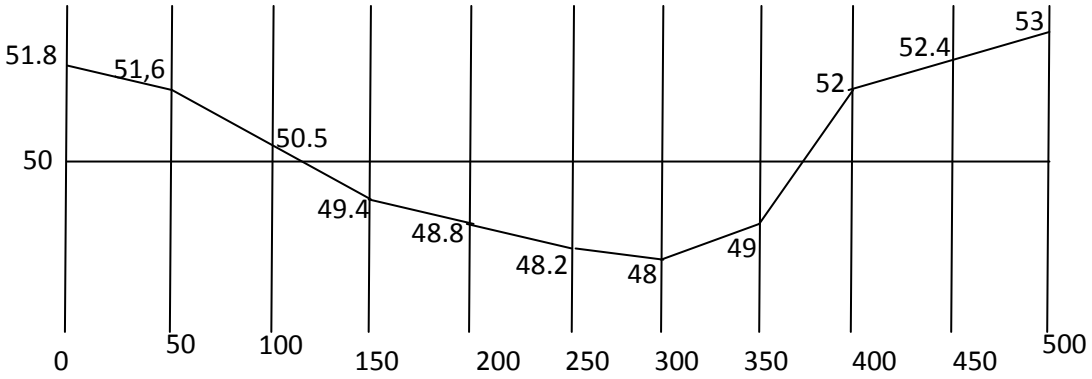
Example 2: Estimate the quantities of earth work to a canal with the following data:

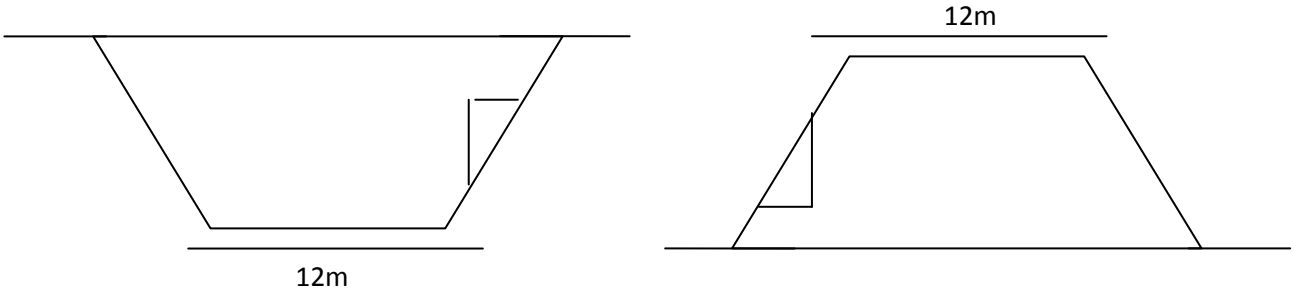
station in meter	**0**	**100**	**200**	**300**	**400**
R.L of ground	**100.2**	**99.8**	**99.6**	**101.3**	**100.3**
R.L of bed	**99**				

Slop of the canal 1/2000.
The bed width of the canal is 3m.
The side slop is 1/1.
The section of canal as show .



Example 3: Estimate the quantities of earth work to a part of road its length 500m & width 12m slop 1:2, its section as show bellow:





Example 4: Find the volume of earth work in embankment of length 12m. Top width is 5.5m and depth is 2.5m the side slopes are 1½:1

Example 5 : The depths at two ends of an embankment of road of length 70m are 2m and 2.5m. The formation width and side slopes are 8m and 2:1 respectively. Estimate the Quantity of earth work by

a) Mid Sectional Area (b)Mean sectional Area method.

Example 6:
The following width of road embankment is 10m. The side slopes are 2:1 The depth along the centre line road at 50m intervals are 1.25, 1.10, 1.50, 1.20,1.0,1.10, 1.15m calculate the Quantity of earth work by:

a) Mid sectional rule
b) Trepezoidal rule
c) Prismoidal rule

Example 7:- Estimate the Quantity of earth work for a portion of road from the following data:

Station	0	1	2	3	4	5	6	7	8	9
RL	7.50	7.70	7.50	7.25	6.85	6.95	6.70	6.45	6.30	5.95

The formation level at station 0 is 8.0 and having falling gradient of 1 in 100. The top width is 12m and side slopes 1½ horizontal to 1 vertical assuming the transverse direction is in level calculate the quantity of earth work Take 1 chain = 20m by using trapezoidal & Prismoidol formula.

Example 8:- The road has the following data:

Station	0	20	40	60	80	100	120
RL of Ground	20.6	21.0	21.5	22.1	22.7	22.9	23.0

The formation level at station zero is 22.0 and having a rising gradient of 1 in 100 the top width is 12.0m and side slopes are1½ :1 Assuming the transverse direction is in level. calculate the quantity of earth work by a) Trepezoidal formula b) Prismoldal formula

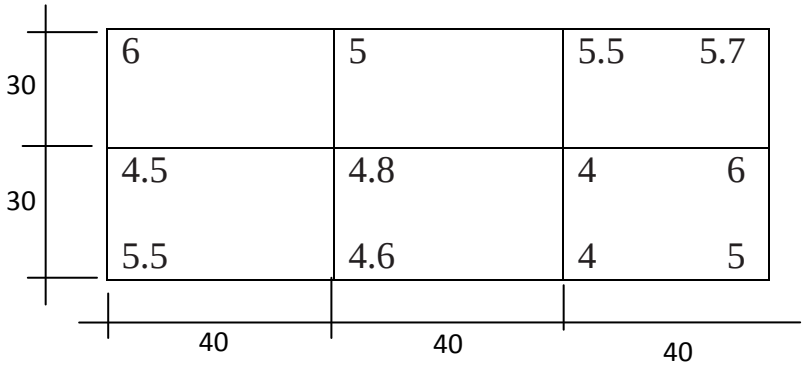
Example 9:- From the problem 7.5 if the gradient is 1 in 100 raising up to 40th station and 1 in 100 falling slop from 40th station to 120th station. Calculate the volume of earth work by using the formulas.

Reticule budget

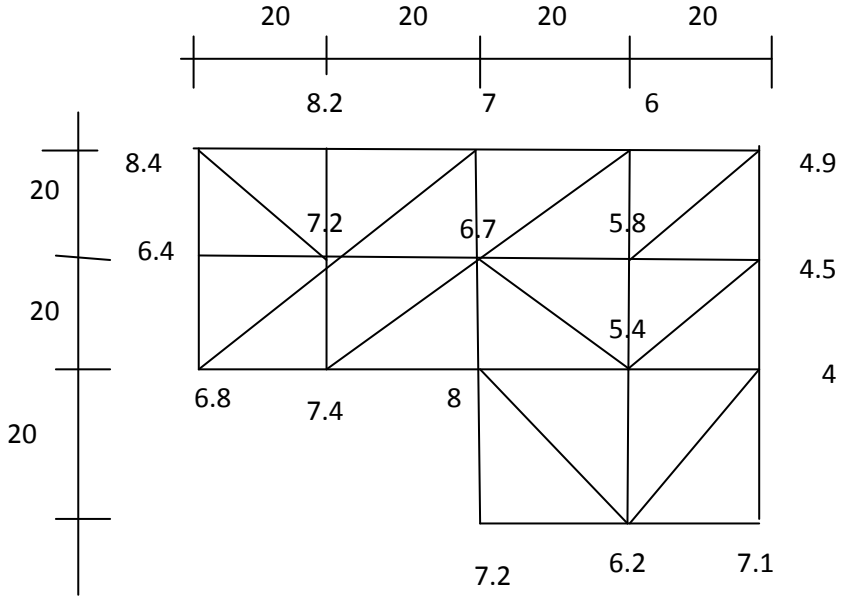
As for the large flat areas, they are divided into squares, rectangles or triangles depend on the accuracy of the work required , then measured the levels of heads , calculated settlement required and in the manner set forth below:

Example 10:

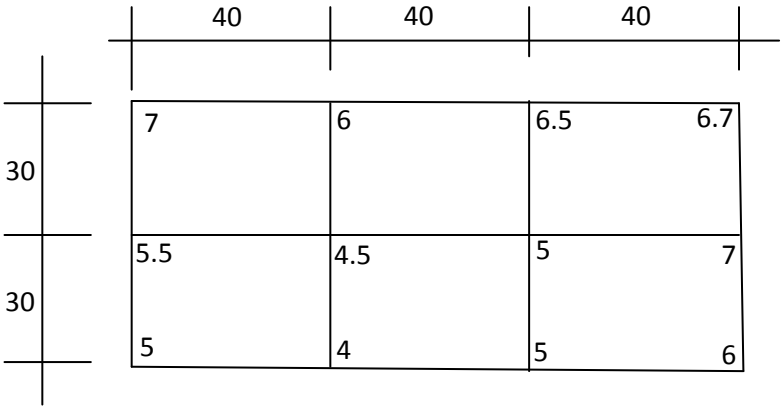
Piece of ground with length 120m and width 60m worked to it reticule budget by divided it to equal rectangular and then put the elevation of rectangular head as shown in figure bellow, calculate the quantity of earth work at elevation of 4m.



Example 11: calculate the quantity of earth work at elevation of 4m.



Example 12: calculate the quantity of earth work at elevation of 5m.



DETAILED ESTIMATE

DETAILED ESTIMATE:

In detailed estimate of building two things are necessarily required. One is the drawings of the work to be estimated and second is the specifications of the different items of work involved. Specifications control the quality of the work. Drawings i.e. plan, elevation and sections, give the dimensions i.e. length, breadth and height or depth of the works, on the basis of which quantity of work is worked out. There is no hard and fast rule for finding out dimensions from the drawings, but the dimensions are to be taken accurately.

The preparation of detailed estimate consists of working out quantities of various items of work and then determine the cost of each item. This is prepared in following stages.

1-**Taking off Dimensions**: measuring from the drawings and entering the dimensions on to specially ruled dimension paper.

2-**Squaring Dimensions**: calculating and totalling the lengths, areas and volumes of the dimensions

3- **Working up Abstractions**: collecting the totals from the dimension paper on to an abstract to produce a final total for each individual description.

4-**Billings** : reproducing the items from the abstract on to bill paper in draft form ready for typing.

1- Taking off Dimensions

RULES FOR MEASUREMENT :

The rules for measurement of each item are invariably described in IS- 1200. However some of the general rules are listed below.

1. Measurement shall be made for finished item of work
2. In booking, the order shall be in sequence of length, breadth and height or thickness.
3. All works shall be measured subject to the following tolerances.

i) Linear measurement shall be measured to the nearest 0.01m.

ii) Areas shall be measured to the nearest 0.01 sq.m

iii) Cubic contents shall be worked-out to the nearest 0.01 cum

4. Same type of work under different conditions and nature shall be measured separately under separate items.
5. The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.
6. In case of masonary (stone or brick) or structural concrete, the 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 Fist floor to Second floor level and so on .

METHODS OF TAKING OUT length:

The quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., can be workout by any of following two methods:

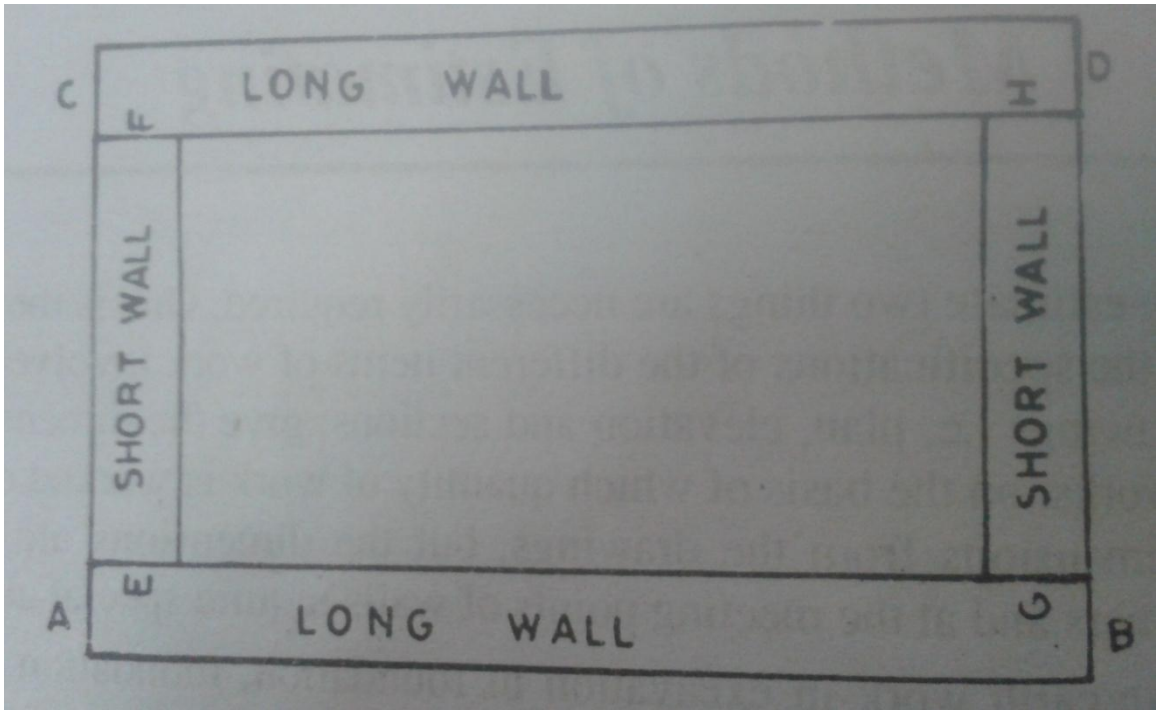
a) Long wall - short wall method

b) Centre line method.

c) Partly centre line and short wall method.

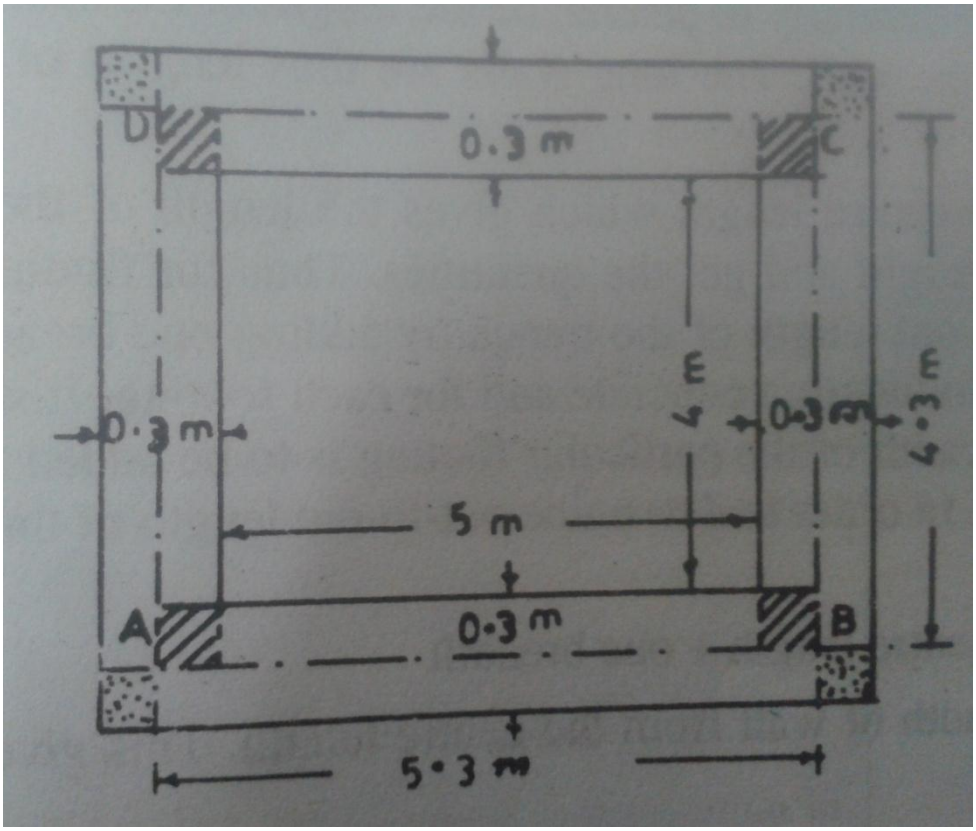
a) Long wall-short wall method:

In this method, the wall along the length of room is considered to be long wall while the wall perpendicular to long wall is said to be short wall. To get the length of long wall or short wall, calculate first the centre line lengths of individual walls. Then the length of long wall, (out to out) may be calculated after adding half breadth at each end to its centre line length. Thus the length of short wall measured into in and may be found by deducting half breadth from its centre line length at each end. The length of long wall usually decreases from earth work to brick work in super structure while the short wall increases. These lengths are multiplied by breadth and depth to get quantities.



b) Centre line method:

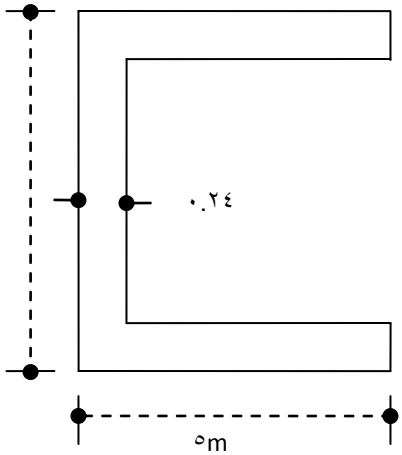
This method is suitable for walls of similar cross sections. Here the total centre line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with main all, the centre line length gets reduced by half of breadth for each junction. such junction or joints are studied carefully while calculating total centre line length. The estimates prepared by this method are most accurate and quick.

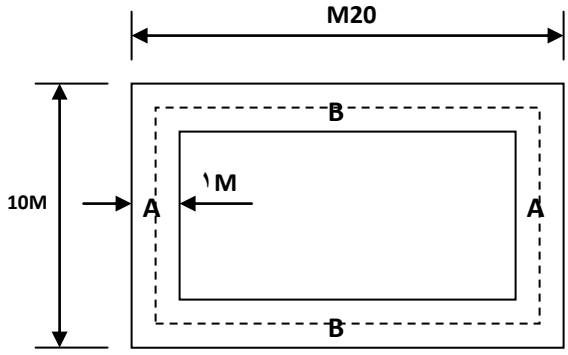


b) Partly centre line and partly cross wall method:

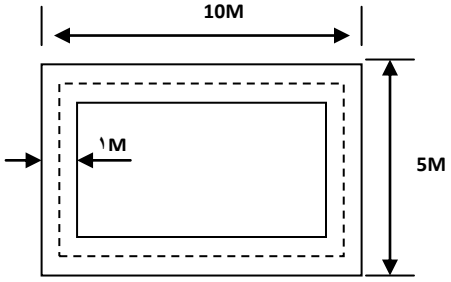
This method is adopted when external (i.e., around the building) wall is of one thickness and the internal walls having different thicknesses. In such cases, centre line method is applied to external walls and long wall-short wall method is used to internal walls. This method suits for different thicknesses walls and different level of foundations. Because of this reason, all Engineering departments are practicing this method

EX1: Calculate the length of the following figures:

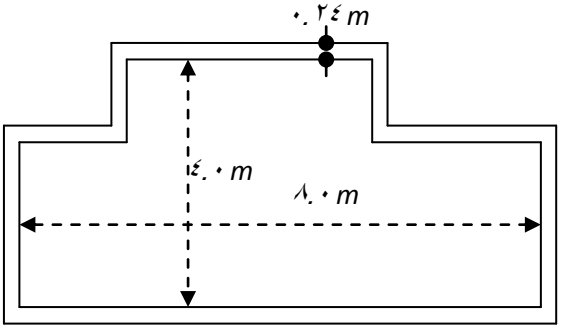




طريقة المحاور



طريقة الخط المركزي



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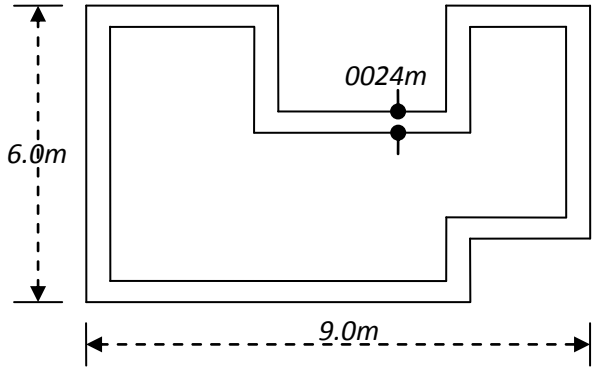

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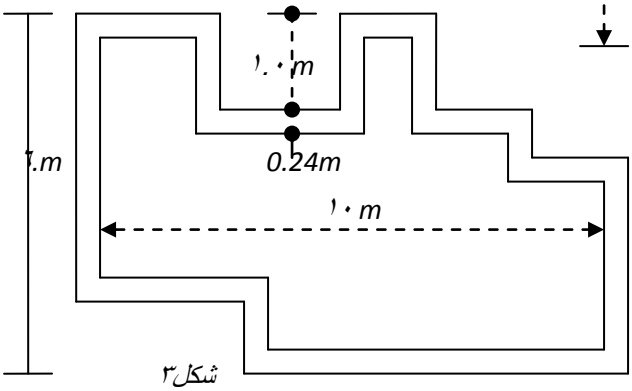

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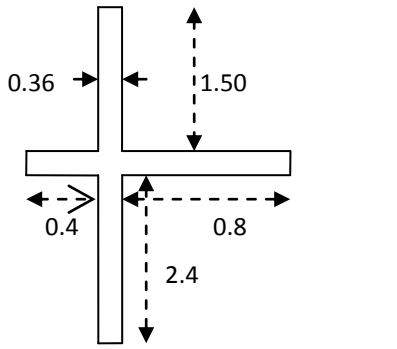
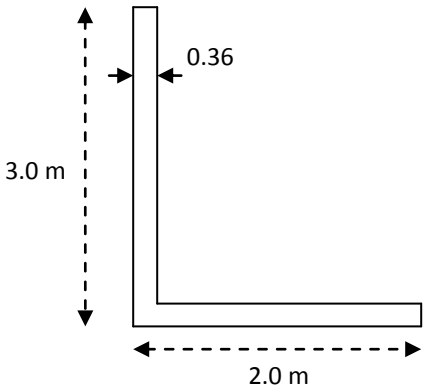
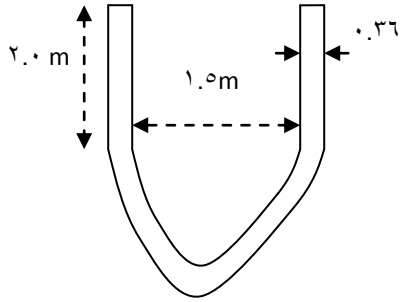


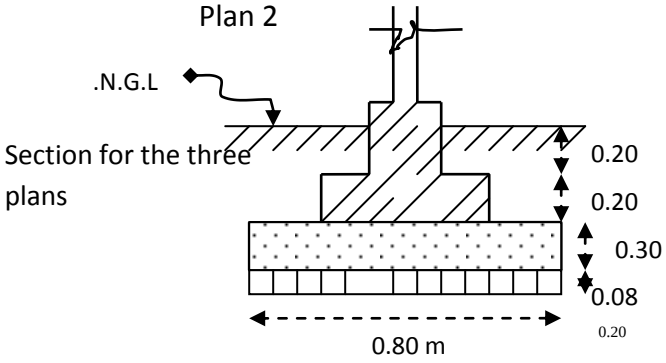
Plan 1



Plan 2



Plan 3



UNITS OF MEASUREMENTS:

The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor.

Type of measurements.

measurements normally consists the following:

1. Numbers
2. running meters (RM)
3. square meters (m2)
4. Cubic meter.

PRINCIPLE OF UNITS FOR VARIOUS ITEMS OF WORKS

The following are the basic principles of units for various items of works:

1. The mass, voluminous and thick works are taken in cubic unit or volume (cu-m).
2. Thin, shallow and surface works are taken in square unit or in area. The thickness shall be specified in the description of item and the measurement of length and breadth is taken, to calculate the area in sq.m.
3. Long and thin work is taken in linear in meters.
4. Piece work, job work, etc. is taken in number.

Unless specifically mentioned in the description of item itself, the rate for any item of work applies equally to all floors, in any position and up to any height. Works are measured net as fixed in the place. The description of the item shall include where

necessary, all charges for storing, delivering, handling, unloading, fabrication, hoisting and labor for fitting, fixing in the position, finishing to required shape and size. Sequence of dimensions is length, breadth or width and height or thickness so;.
a) Single units work like doors, windows, trusses etc., are expressed in numbers.
b) Works consists linear measurements involve length like cornice, fencing, hand rail, bands of specified width etc., are expressed in running meters (RM)
c) Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc., are expressed in square meters (m2)
d) Works consists cubical contents which involve volume like earth work, cement concrete, Masonry etc are expressed in Cubic meters.

Details of measurements and calculation of quantities:
The complete work is divided into various items of work such as earth work concreting, brick work, R.C.C. Plastering etc., The details of measurements are taken from drawings and entered in respective columns of prescribed proofread. the quantities are calculated by multiplying the values that are in numbers column to Depth column as shown below:

Dimension paper
Group System:
The ruling of dimension paper should conform to the requirements of BS3327—Stationery for Quantity Surveying, and the paper is vertically separated into two parts by a double line each with four columns (Figure 1).

Column A is the ‘time sing’ and ‘dotting on’ column where multiplication and addition of the dimensions can be recorded (Figure 2).

A	B	C	D
5/	2	10	2 multiplied by 5
3.5/	2	16	2 multiplied by the sum of 3 and 5
5/	6.00 7.00	210.00	5 superficial areas with sides 6m and 7m long
2/3.5/	6.00 7.00	672.00	A superficial area with sides 6m and 7m long multiplied by the sum of 3 and 5 and further multiplied by 2

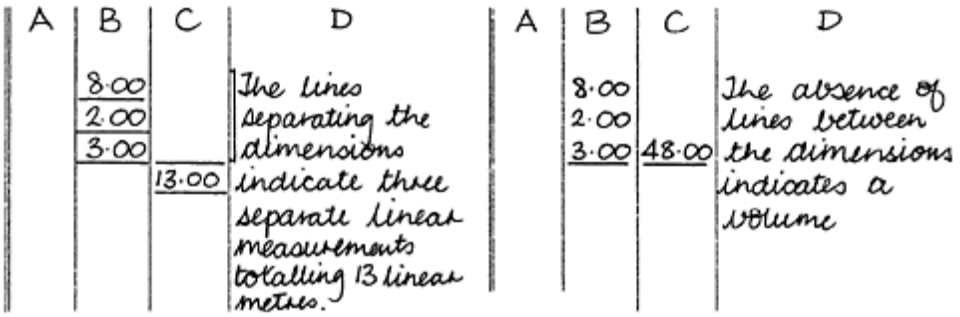
A	B	C	D
π/	2.00 2.00	12.57	a circle with a 2 metre radius multiplied by pi (3.142)
4/½/	4.00 2.00	16.00	Four triangles with base 4 metres and height 2 metres multiplied by ½ to produce the area.

Column B is the dimension column and receives the measurements taken off from the drawings. The dimensions are normally expressed to two decimal points (Figure 3).

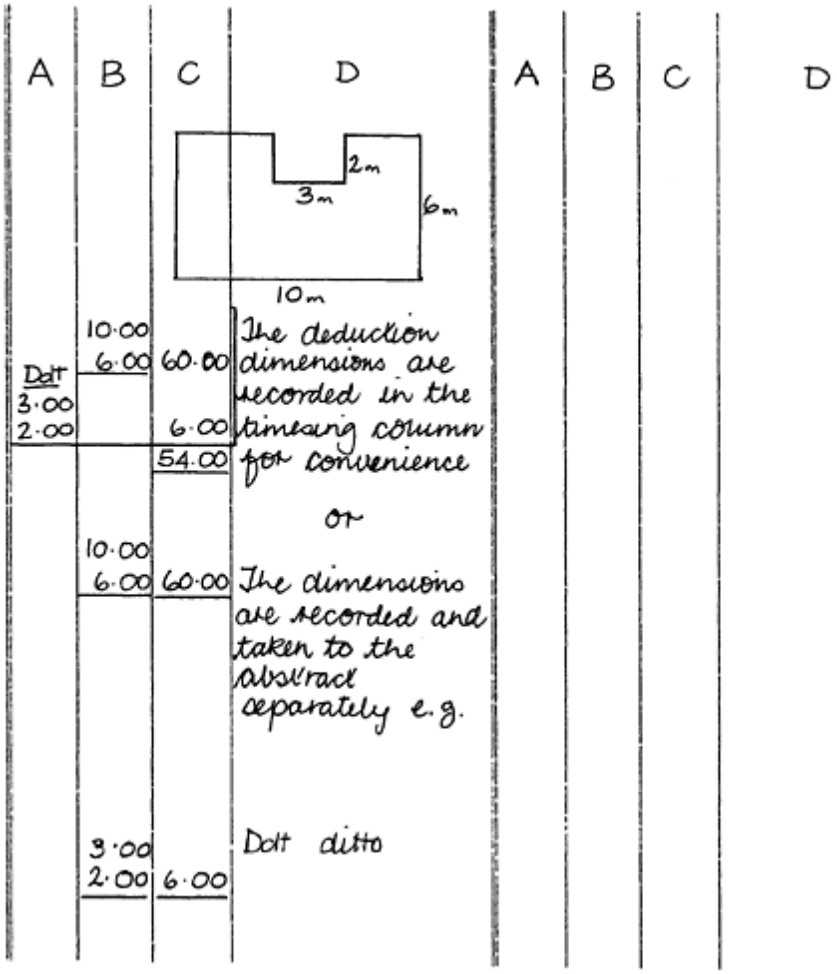
A	B	C	D
	6	6	This represents an item which is repeated 6 times
6/	1	6	The same item can be expressed as 6 times 1
	8.00	8.00	Length of 8 metres
	8.00 2.00	10.00	Lengths of 8 and 2 metres added together
	8.00 2.00	16.00	Area of 16 square metres with sides of 8 and 2 metres

A	B	C	D
	8.00 2.00 3.00 5.00	16.00 15.00 31.00	Two areas totalling 31 square metres
	8.00 2.00 3.00	48.00	A volume of 48 cubic metres consisting of length 8 metres width 2 metres and depth of 3 metres
	8.00 2.00 3.00 3.00 3.00 2.00	48.00 18.00 66.00	Two volumes totalling 66 cubic metres.

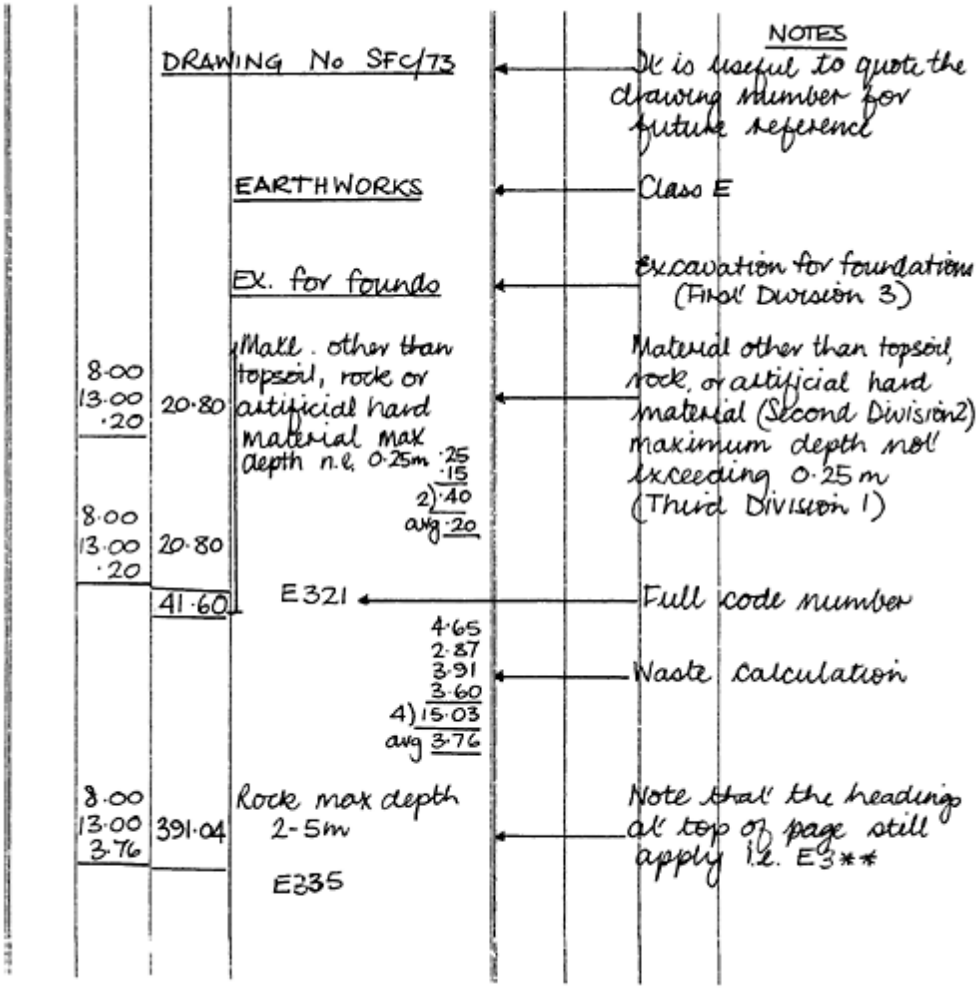
It is important to note that it is the insertion of the horizontal line which determines whether the dimension is intended as a linear, superficial or cubic measurement (Figure 4). The dimensions should always be recorded in the order of length, width and height.



Column C is the squaring column where the result of the addition, subtraction or multiplication of the entries in the dimension column is recorded. Figures which are to be added or subtracted are bracketed together in the manner shown.
Deductions are sometimes necessary where it is easier to take an overall measurement and deduct the parts not required (Figure 5).



Column D is the description column where the item being measured is described. This is done by using a form of standard abbreviations which have been listed separately. This column also contains annotations giving the location of the dimensions and waste calculations which show the build up of the figures entered in the dimension column. (Figure 6).



Quite often two item descriptions share the same measurement and this is indicated by linking the descriptions with an ampersand. It may be considered desirable to insert the appropriate CESMM 3 code in the description column as shown in Figure 6, but the value of doing this will depend upon the subsequent method of processing the dimensions and descriptions that is adopted.

Trade system

S.No	Description of Item	No	Length (L) m	Breadth (B) m	Depth/ Height (D/H)m	Quantity +	Quantity -	Quantity	Explanatory Notes

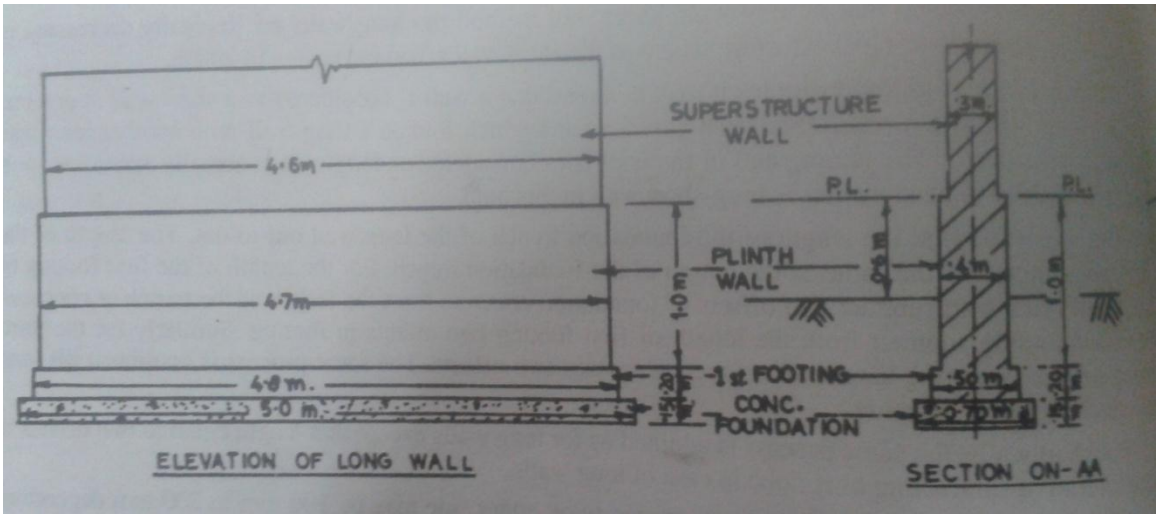
Bill paper

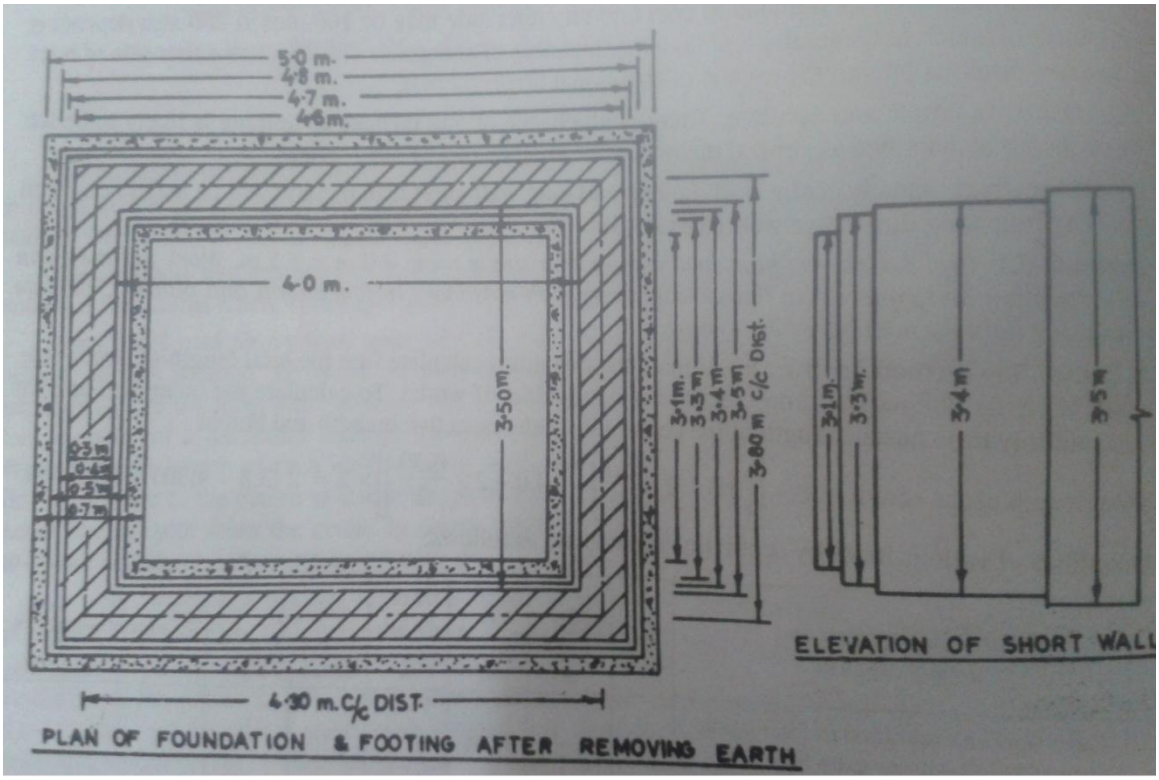
Item No.	Description/Particulars	Unit	Quantity	Rate Per(Unit)	Amount

The detailed estimate should accompanied with
i) Report
ii) Specification
iii) Drawings (plans, elevation, sections)
iv) Design charts and calculations
v) Standard schedule of rates.

Ex:

Figure (3) shows plan and section of a single room 4m * 3.5m. Work out the earth work in excavation and concrete in foundation along with masonary in foundation. Calculate quantities using both the methods of estimating.




5·0 m.
4·8 m.
4·7 m.
4·6 m.
4·0 m.
3·50m.
0·3 m
0·4 m
0·5 m
0·7 m
4·30 m. C/c DIST.
PLAN OF FOUNDATION & FOOTING AFTER REMOVING EARTH
3·1m.
3·3m
3·4 m
3·5m
3·80 m c/c Dist.
3·1m.
3·3m.
3·4 m
3·5 m
ELEVATION OF SHORT WALL

ANALYSIS OF RATES

Definition : In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.
The rate of particular item of work depends on the following.
1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity and transportation of materials and their costs.
3. Cost of labors and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

1. Quantities of Materials and their Costs:

The includes the quantities of various materials for unit quantity of an item followed by the specification and costs of various materilas. the cost includes first cost, freight, transportation and insurance charges.

Labor and Cost:

This includes the number and wages of different categories of laborers. Skilled, unskilled etc.,

Cost of Equipment:

For big projects it is necessary to use special type of tools and plants like special type of mixed concrete transport vehicle called tripling wagons, cranes etc. in order to purchase such tools and plants and amount of 2 to 3% of estimated cost is provided in the estimate.

Over head Charges:

This includes office rent, depreciation of equipments, salaries of office staff, postage, lighting travelling allowances, telephone bills. the contractor may provide small tooks like ladders, trowels, ropes etc., fo his workmen. Here an amount of 5% of estimated cost is provided towards overhead charges.

Profit :

Generally 105 of estimated cost is considered for contractor's profit after allowing the charges of equipments and establishments. For small job s 15% and large works 8% profit is considered.

2. Standard Data Book:

This book gives the quantities of materials and labour required for unit item of work.

3. Standard scheduled of rates:

The rates of materials and wages of laboures are fixed by superintending Engineer for this circle for every year. And these rates are approved by board of engineers.

4. Data:

The process of working out the cost or rate per unit of each item is called as Data. In preparation of Data, the rates of materials and labor are obtained from current standard scheduled of rates and while the quantities of materials and labor required for one unit of item are taken from Standard Data Book (S.D.B)

Fixing of Rate per Unit of an Item:

The rate per unit of an item includes the following:

i) ***Quantity of materials & cost:***

The requirement of materials is taken strictly in accordance with standard data book (S.D.B). The cost of these includes first cost, freight, insurance and transportation charges.

ii) ***Cost of labor:***

The exact number of laborers required for unit of work and the multiplied by the wages/ day to get of labor for unit item work.

iii) ***Cost of equipment (T&P):***

Some works need special type of equipment, tools and plant. In such case, an amount of 1 to 2% of estimated cost is provided.

iv) ***Overhead charges:***

To meet expenses of office rent, depreciation of equipment salaries of staff postage, lighting an amount of 4% of estimate cost is allocated.

Cost of labor -types of labor, standard schedule of rates

The labor can be classified in to

1) Skilled 1st class
2) Skilled 2nd Class
3) un skilled

The labor charges can be obtained from the standard schedule of rates 30% of the skilled labor provided in the data may be taken as Ist class, remaining 70% as II class.

Calculation of quantities of materials / unite:

1. Brick work.
2. Block work
3. Cement mortar.
4. Cement concrete.
5. 1 sqm flooring.
6. 1 sqm plastering.
7. R.C.C (steel quantities).

1. Brick work.

The standard size for a brick is accepted to be (23 × 11 × 7) cm thick; however, when the mortar is included this becomes (24 × 12 × 8) cm thick. Therefore a one brick wall will be assumed to be 24 cm thick and a two brick wall 48 cm thick. Bricks are delivered to site pre-packed on tracks and bought by the thousand, except for specially made units. Bricks can be broadly categorized as follows:

Common bricks: these are suitable for general building work where the finish is not important. Common bricks are made from clay and are cheaper than other alternatives.

Facing bricks: facings come in a wide variety of finishes, colors, strengths and prices and are used typically in the external skin of cavity walls. Also made from clay, facing bricks are weather resistant and generally finished with pointed joints.

Engineering bricks: these bricks have low water absorption properties and a high compressive strength. Typically used in retaining walls, bridges and manholes.

2. Block work

Block work comes in larger units than brickwork with the standard size being (40 *20 *20) cm, as well as a variety of thicknesses. As with brickwork, once the mortar is included this becomes (41*21*20) cm, therefore six standard bricks are equal in size to one block; an important fact, as bricks and blocks are used for inner and outer skins of hollow walls. Types of block are:

Dense block work

Dense blocks are suitable for above and below ground situations and are made from cement, sand and crushed gravel.

Lightweight block work

Lightweight blocks include lightweight aggregates and are generally used for the internal skins of external walls or where a high degree of thermal insulation is required. They are lighter and easier to handle on site than dense concrete blocks with poor sound insulation qualities.

Materials quantities calculations in one cum of brick work :

- Normal size of one brick before building (23 × 11 × 7) cm
- Volume of brick before building (23 × 11 × 7) / (1000 000) = .001777 cum.
- Normal size of one brick after building (24 × 12 × 8) cm
- Volume of brick after building (24 × 12 × 8) / (1000 000) = .023 cum.
- No. of bricks required / cum = 1/ 0.023 = 435
- Volume of mortar/ cum brick work = 1 - 0.00177 * 435 =0.23 cum.

Materials required for 12 cm thick of brick work :

- Quantities of brick work = one sqm.
- The face dimensions 8, 24.

- The area of the brick after building = 0.08 * 0.24 = 0.0192 sqm.
- No. of brick in one sqm = 1/ 0.0192 = 52.
- The area of brick in 1 sqm = 0.07 * 0.23 * 52 = 0.84sqm
- Volume of mortar = 0.16 * 0.11 = 0.0176 cum.

HOME WORK : Materials required for 8 cm thick of brick with cement mortar work.

EX:

How many bricks are you need to built room with (4*5*3) m, thickness of walls 0.24 m ,have one door its dimensions (1* 2.1)m and one window (1.5*1.5)m its roof from brick with thickness 0.12 m. what is the volume of cement mortar.

Materials required for cement mortar:

There are a variety of commonly used mortar mixes that should match the type, location and strength of the masonry. As a general rule the mortar should not be as strong as the brick or block, there by allowing any cracking to take place in the joint and not the masonry. Therefore, a mortar mix of cement :sand (1:3) would be classed as a strong mix whereas a mix of cement: lime :sand (1:1:6) would be classified as a weaker mix.
mix ratio, 1:2 are used for blustering .
Materials in cement mortar are cement and fine sand, to know the quantity of cement and sand in one cubic meter we must know the
SP .Wt of concrete= 1440 kg/m3 (or) 1.44 t/m3
1 bag of cement = 50 Kg

Example :-

Calculate the quantity of materials for the following items.
a) C.M. (1:3) for 1m3 of work
b) CM (1:2) for 1m3 of work
Hint: Cement will go to fill up the voids in sand. So total volume was be 3 instead of 1+3=4

a) Quantity of Cement required = $\frac{1}{3} * 1 = 0.33 * 1440/50 = 9.5\ bag$
   Sand = 0.33 * 3 = 0.99 m3/cum

b) Quantity of Cement required = $\frac{1}{2} * 1 = 0.5 * 1440/50 = 14.4\ bag$
   sand = 0.5 * 2 = 1 m3/cum

Ex: how many bags of cement and cum of sand we need to build the room in last exercise .

Materials required for 1 sqm plastering:

1 sqm plastering = 1*1*0.02 = 0.02 cum of mortar
Ex :how many bags of cement and cum of sand we need to plastering the out side walls of the room in ex .above.

*** Materials required for 1 cum cement concrete:**
Concrete mixes are described by the volume or strength of the ingredients. For example (1:2:4), this refers to a mix that is, by volume:
1 part Portland cement
2 parts sand
4 parts aggregate

- When water is added during the mixing process the materials combine together and reduce in volume by approximately 40%, although the percentage will depend on the mix of the concrete.
- For 1m3 wet concrete = 1.52m3 dry concrete approximately
- SP.Wt of concrete= 1440 kg/m3 (or) 1.44 t/m3
- 1 bag of cement = 50 Kg
-

Quotations for sand and gravel can be per cubic meter

Ex: Calculate the quantity of Cement required in bags for the following items of work.
a) C.C. (1:4:8) for 30m3of work
b) masonry in CM(1:5) of 0.34m3 of CM for 1m3 of masonry for 20m3 of work
Note: For 1m3 wet concrete = 1.52m3 dry concrete approximately
SP .Wt of concrete= 1440 kg/m3 (or) 1.44 t/m3
1 bag of cement = 50 Kg

a) $\mathbf{X = \frac{1}{1+4+8} * 1.52 = 0.117}$
Quantity of Cement required = 0.117 * 1440 * 30 = 5054.4 / 50 = 101 bag
Quantity of sand required = 0.117 * 2 = 0.234 cum
Quantity of aggregate required = 0.117 * 4 = 0.468 cum

*** Materials required for 1**sqm white plastering:
Volume of unslaked lime(Joes) /sqm = 1*1*0.02 = 0.02 cum
Density of unslaked lime(Joes) = 1275 kg/m3
unslaked lime(Joes) lose 10% from it weight when it used.
Weight of unslaked lime(Joes) = 0.02 * 1275 * 1.1 = 28.3 kg

*** Materials required for 1**sqm flooring with mosaic tiles :

Dimensions of the tiles.
Thickness of the cement mortar between tiles from(2 to 4)mm
If the dimensions of tiles = (25 *25) cm
Dimensions after building =(0.253 * 0.253)sqm
No. of tiles = 1/ 0.253 * 0.253 = 16

Factors to be taken into account when pricing concrete work items are:
□□Whether ready mixed concrete is to be used or if concrete is to be mixed on site. It is usually found that on site, where access is not a problem and where reasonably large quantities of concrete are required over a regular period, it is better and more economical to set up a batching plant to mix concrete. On a restricted site or where small quantities of concrete are required, it is probably better to use ready mixed concrete, as it will be the cheaper alternative
□□Assuming that concrete is to be mixed on site, whether bagged or bulk cement is used. Bagged cement is delivered in 50 kg bags and has to be unloaded and stored in a dry location, whereas bulk cement is stored in a silo next to the mixer and is cheaper. Bagged cement also tends to be more wasteful
□□If concrete is to be mixed on site, the best position for the mixing plant from the point of view of transporting the mixed concrete around the site
□□The type and size of mixer to be used based on the output required
□□The method of hoisting, placing and compacting the mixed concrete and whether a tower crane is to be used. Concrete may be transported by dumper or barrow, or be pumped
□□The cost of any measures necessary to protect the poured concrete either due to excessive drying out in hot weather or damage from frost and low temperatures
□□

On rare occasions concrete may have to be mixed by hand (a backbreaking and labour-intensive process); 4 hours/m3 labour should be

allowed for hand mixing concrete on a wooden board.

Labour constants

The following constants are average labour constants for mechanical mixing, transporting up to 25 metres, placing and compacting:

Hours/m3 labour

Plain in situ concrete

Foundations not exceeding 300 mm thick poured on or against earth or hardcore 2.0

Ditto exceeding 300 mm thick ditto 1.5

Beds over 150 mm not exceeding 450 mm thick ditto 3.0

Reinforced in situ concrete

The following constants are average labour constants for mechanical mixing, transporting up to 25 metres, placing and compacting, packing around reinforcement and into formwork if necessary:

Hours/m3 labour

Foundations not exceeding 300 mm thick poured on or against earth or hardcore 4.0

Beds over 150 mm not exceeding 450 mm thick ditto 4.5

Walls thickness 150–450 mm thick 6.0

Slabs thickness 150–450 mm thick 6.0

Columns 8.0

Example

Reinforced in situ concrete (1:2:4) in ground beams, thickness over 150, not exceeding 300 mm thick poured on earth – cost per m3.

Data

Portland cement: £85.00 per tonne delivered to site

Sand: £10.00 per tonne delivered to site

Course aggregate: £9.00 per tonne delivered to site

Materials	£	£
1 m3 cement = 1400 kg cement @ £85.00 per tonne		119.00
Unloading 1 hour/tonne @ £13.20 per hour		18.48
2 m3 sand = 3200 kg @ £10.00 per tonne		32.00
4 m3 aggregate = 5600 kg @ £9.00 per tonne		50.40
		219.88
Add shrinkage 40%		87.95
		307.83
Add waste 2.5%		7.70
Cost per 7 m3		£315.53
Cost per m3 ÷ 7	£45.08	45.08

Mixing

Assume 200 litre mechanical fed mixer @ £20.00 per hour

Output 4 m3 per hour – cost per m3 5.00

Placing

4 hours labour @ £13.50 54.00

104.08

Add Profi t and overheads 15% 15.61

Cost/m3 **£119.69**

Mixer outputs in m3 of concrete per hour

Hand loaded

100 litre 150 litre 175 litre 200 litre

2.2 1.8 2.1 2.4

3. Reinforcement

4. It is usual for bar reinforcement to be delivered to site, cut to length

5. and bent in accordance with the bending schedules. Steel fi xers are

6. entitled to additional payments in accordance with the Working

7. Rule Agreement. Reinforcement is usually fi xed by black tying wire.

8. Five per cent should be added for binding wire and rolling margin.

9. Allow four hours per tonne labour for unloading.

10.Labour constants

11. Labour cutting, bending and fi xing reinforcement, per 50 kg:

12.□□10 mm diameter bars: 4.00 hours

13.□□10 mm–16 mm bars: 3.00 hours

14.□□over 16 mm bars: 2.75 hours.

15.Fabric reinforcement

16. As an average 30 m2 per hour should be allowed for cutting and fi xing

17.fabric reinforcement. An allowance of 12.5–15% for waste and laps

18.should be made and the areas in the bills of quantities will be net

19.areas and exclude laps between sheets.

20.Example

21. Fabric reinforcement (ref. A252) weighing 3.95 kg/m2 with 150 mm minimum

22.side and end laps – cost per m2.

23.Data

24. Fabric reinforcement: A252 mesh reinforcement, weighing 45.5 kg size

25.4800 × 2400 mm – £55.00 (11.52 m2)

26. Assume 23 m2 (approximately two sheets)

27.Material £

28.23 m2 of fabric A252 reinforcement delivered to site 110.00

29. Add 15% laps and waste 16.50

30.126.50

31. Labour 23 hours steelfi xer @ £17.76 13.62

32.30

33. Cost per 23 m2 140.12

34. Add Profi t and overheads 15% 20.02
35.162.14
36.÷23 cost per m2 £7.05
37.Formwork
38. Formwork supports and forms the poured concrete until such time as
39.the material has reached its design strength and then the formwork
40.can be struck, or taken down. Traditionally, formwork, which has to
41.bear considerable weight, was made from timber and erected by a
42.carpenter, but latterly metal forms and props have become more commonplace
43.as they can be used more often than the timber equivalent.
44. Metal formwork is more expensive than using timber, but the time
45.taken to erect is considerably less and uses less labour both skilled
46.and unskilled. If timber formwork is used the amount to which the
47.formwork can be reused has a considerable effect on the cost. Timber
48.formwork to large areas such as fl oor slabs can be reused more often
49.than formwork to smaller items such as columns or beams. Formwork
50.can also be used to produce fair face or textured fi nishes to the
51.face of the concrete, or if the fi nished structure is to be hidden from
52.view it can be left ‘as struck’.
53.A typical build-up for metal formwork would be as follows:
54.□□Hire cost of metal formwork and props delivered to site for the
55.required period
56.□□Labour: fi xing and stripping
57.□□Any treatment to the face of the formwork
58.□□A small allowance to cover end pieces, etc. which may have to be
59.made from timber.
60. The following are average labour constants for fi xing and stripping
61.metal formwork and are in skilled hours per m2:
62.Fix Strip
63. Horizontal soffi t of slab over 200 mm not
64.exceeding 300 mm thick 1.80 1.00
65. Sloping soffi t not exceeding 15□□of slab over
66.200 mm not exceeding 300 mm thick 2.50 1.20
67. Vertical walls 2.00 1.00
68. The following are average labour constants for fi xing and stripping
69.metal formwork and are in skilled hours per metre:
70.Fix Strip
71. Edges of suspended slabs height not
72.exceeding 250 mm 0.20 0.10
73.Precast concrete units
74. Items such as lintels, sills, copings and plank fl oors come to site as

75.precast units ready to be placed into position. To the prime cost of
76.the precast units the additional costs of the following items should
77.be considered:
78. Unloading and stacking
79. Hoisting and bedding in place
80. Material for bedding
81. Waste (damaged or broken units) – 2.5%
82. Profi t and overheads.
83. Allow 0.30 hour bricklayer and labourer per linear metre for hoisting
84.and fi xing a 225 × 150 mm lintel up to 3 metres above ground.

Example 1:- Calculate the Quantity of material for the following items.
a) C.C. (1:2:4) for 20m3 of work
b) C.C. (1:3:6) for 15m3 of work

Example 2:- Calculate the quantity of materials for the following items.
a) C.M. (1:4) for 1m3 of work
b) CM (1:6) for 1m3 of work
Hint: Cement will go to fill up the volds in sand. So total volume was be 4 instead of 1+4=5

Example 3:-Calculate the Quantity of Cement required in bags for the following items.
a) B.M. in CM(1:3) for 15 cum of work using 0.2m3 of CM required for 1m3 of Brick work
b) C.C (1:2:4) for 20m3 of work

Example 4:-