RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING.

Experiment No: 01

Name of the experiment: Estimation.

Name: Noushin Tabassum Tasnim.

Class: 2nd year, even semester.

Roll: 1800130.

Section: C.

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ESTIMATION

Estimation: Estimation is the scientific way of working out the approximate cost of an engineering project before the execution of the work.

- It is totally different from calculation of the exact cost after completion of the project.
- Estimation requires a thorough knowledge of the construction procedures and cost of materials and labour in addition to the skill, experience, foresight and good judgment.

Estimate: An estimate of the cost of a construction job is the probable cost of that job as computed from plans and specifications.

- For a good estimate, the actual cost of the proposed work after completion should not differ by more than 5 to 10% from its approximate cost estimate, provided there are no unusual, unforeseen circumstances.

Need for estimate:

(1) It helps to workout the approximate cost of the project in order to decide its feasibility with respect to the cost and to ensure the financial resources, if the proposal is approved.

(2) Requirements of controlled materials, such as cement and steel can be estimated for making applications to the controlling authorities.

(3) It is used for framing the tenders for the works and to check contractor's work during or after the execution of the purpose of making payments to the contractor.

(4) From quantities of different items of work calculated in detailed estimation, resources are allocated to different activities of the project and ultimately their durations and whole planning and scheduling of the project is carried out.

Site conditions affecting the overall cost:

(1) Each type of work requires a different method of construction. Construction may be an ordinary house or office and it may also be of a dam, tunnel, multistoried building, airfort, bridge or a road, already in operation. Each of these works requires totally different construction techniques, types of machinery and formwork.

(2) Quality of labour and labour output varies in different localities.

(3) Weather conditions greatly affect the output and hence the overall cost.

(4) Ground conditions vary and change the method of construction For example, excavation may be dry, wet, hard, soft, shallow or deep requiring different efforts.

(5) The work may be in open ground such as fields or it may be in congested areas such as near or on the public roads, necessitating extensive watching, lighting and controlling effects etc.

(6) The source of ability of a sufficient supply of materials of good quality is also a factor.

(7) The availability of construction machinery also affects the method of construction.

(8) Access to the site must be reasonable. If the access is poor, temporary roads may be constructed.

Essential qualities of a good estimator:

- In preparing an estimate, the estimator must have good knowledge regarding the important rules of quantity survey.
- He must thoroughly understand the drawings of the structure, for which his going to prepare an estimate.
- He must also be clearly informed about the specifications showing nature and classes of works and the materials to be used because the rates at which various types of works can be executed depend upon its specification.

A good estimator of construction costs should posses the following capabilities also:

(1) A knowledge of the details of construction work.

(2) Experience in construction work.

(3) Having information regarding the materials required, machinery needed, overhead problems and costs of all kinds.

(4) Good judgment with regard to different localites, different jobs and different workmen.

(5) Selection of a good method for preparing an estimate.

(6) Ability to be careful, thorough, hard working and accurate.

(7) Ability to collect, classify and evaluate data relating to estimate.

(8) Ability to visualize all the steps during the process of construction.

Before preparing the estimate, the estimator should visit the site and make a study of conditions there. For example, if the construction of a large buiding is planned, the estimator or his representative should visit the site and:

- Note the location of the proposed building.
- Get all data available regarding the soil.
- Make a sketch of the site showing all important details.
- Obtain information concerning light, power and water.
- Secure information concerning banking facilities.
- Note conditions of streets leading to railway yards and to material dealers.
- Investigate general efficiency of local workman.

Types of estimates:

- There are two main types of estimates:
  (1) Rough cost estimate.
  (2) Detailed estimate.

- Depending upon the purpose of estimate, some types of detailed estimates are as follows:
  (a) Contractor's estimate.
  (b) Engineer's estimate.
  (c) Progress estimate.

Rough cost estimate:

- Estimation of cost before construction from plans or architechtural drawings of the project scheme, when even detailed or structural design has not been carried out, is called rough cost estimate.

- These estimates are used for obtaining administrative approval from the concerning authorities.

- Sometimes, on the basis of rough cost estimates, a proposal may be dropped altogether.

- Unit cost is worked out for projects similar to the project under consideration carried out recently in nearly the same site conditions.

- Unit cost means cost of execution of a unit quantity of the work.

- To find rough cost of any project, this worked average unit cost is multiplied with total quantity of the present work in the same units.

- For example, in case of a building, plinth area (sq. ft) of the proposed building is worked out, which is then multiplied by the cost per unit are (Rs./ft^2) of similar building actually constructed in the near past in nearly the same site conditions, to find out the rough cost estimate of the building.

- This cost is sometimes adjusted by the average percentage rise in the cost of materials and wages.

The rough cost estimate may be prepared on the following basis for different types of projects:

(1) Cost per square foot of covered area (plinth area) is the most commonly adopted criterion for preparing rough cost estimate for most of the residential buildings.

(2) For public buildings, cost per person (cost per capita) is used. For example,

Students hostel ——— cost per student.

Hospitals ——————— cost per bed.

Hotel ——————————— cost per guest.

(3) Cost per cubic foot is particularly suitable for commertial offices, shopping centers and factory buildings etc.

(4) For water tank or reservior, cost may be worked out on the basis of capacity in gallons of water stored.

(5) For roads and railways, cost may be found out per mile or kilometer of length.

(6) For streets, cost may be per hundrend feet or meters of length.

(7) In case of bridges, cost per foot or meter of clear span may be calculated.

Detailed Estimate:

- Detaled estimates are prepared by carefully and separately calculating in detail the costs of various items of the work, that constitute the whole project from the detailed working drawings after the design has been finalized.

- The mistakes, if any, in the rough cost estimate are eliminated in the detailed estimate.

- Detailed estimates are submitted to the competent authorities for obtaining technical sanction.

- The whole project is sub-divided into different items of work or activities. The quantity for each item is then calculated separately from the drawings as accurately as possible. The procedure is known as "taking out of quantities."

- The quantities for each item may be estimated and shown in the pattern which is called "Bill of quantities".

- The unit, in which each item of the work is to be calculated, should be according to the prevailing practice as followed in various departments of the country.

Here is a sample chart of "Bill of quantities."

Sl NO.	Description of items	No.	Measurement			Quantity	Total Quantity	Remarks
			Length	Breadth	Height			

Here is a sample chart of "Priced bill of quantites:"

Sl. NO.	Description of Item.	Unit	Quantity	Rate	Cost	Remarks

- Each item of the work then multiplied by its estimated current rate calculated by a fixed procedure to find out cost of the item.
- At the end, a total of all items of the work are made to get the total estimated cost.
- The rates are usually as per schedule of Rates for the locality plus a premium to allow for rise in labour and material rates over and above the schedule of rates.
- A percentage, usually 5% is also provided on the total estimated cost for the work to allow for the possible contingencies due to unforeseen items or expenditure on other causes, besides 2% establishment charges.

⊞ Besides drawings and details of measurements and calculation of quantities (Bill of quantities), the following documents are also usually submitted with the detailed estimate for obtaining technical sanction.

(1) A report explaining history, necessity, scope and main features of the project, its design and estimate etc.

(2) Specifications lying down the nature and class of work and material to be used in various parts of the work.

(3) The abstract of cost (priced bill of quantities) showing the total quantities under each sub-head, per unit rate of measurement and cost.

(4) Calculation sheets showing calculation for important parts of the structure. In fact, in estimating the art and skills lies only in the computation of details without any omissions, of all parts of the building of work.

1. Constractor estimate:

- It is made by the contractor for determining the price or prices to be bid.
- It is usually a carefully prepared detailed estimate.

2. Engineer's estimate:

- This type of estimate is made by the engineer (consultant) usually for the perpose of financing the work and for checking bids and running bills submitted by contractors.

3. Progress estimate:

- These are made by the engineer at regular intervals for the completed parts of the project during the progress of the work for determining the amounts of partial payments to be made to the contractor.
- On large contracts, such estimates are commonly made each month and hence, are frequently called mothly estimates.

Unforseen items in detailed estimate:

- While preparing a detailed estimate, one had to be very careful to see that all items of the work are incorporated.
- It is likely that a few items, though unimportant in nature, might have been overlooked and which may result in raising the estimate of the project.
- There may be also certain unforseen circumstances affecting the project.
- Hence, a certain allowance usually 5 to 10% of the total cost, is made in the estimation which will take care of all these items that are unforseen or are overlooked and are known as 'contingencies'.

Methods of Detailed Estimate:

- The dimensions, length, breadth and height or depth are to be taken out from the working drawings (plan, elevation and section.).

- Junctions of walls, corners and the meeting points of walls require special attention.

- For symmetrical footings, which is the usual case, earthwork in excavation in foundations, foundation concrete, brickwork in foundation and plinth and brickwork in super structure may be estimated by either of the two methods:

  (1) Separate or individual wall method,

  (2) Center line method.

1) Separate or individual walls method:

- The walls running in one direction are termed as 'long walls' and the walls running in the transverse direction, as 'short walls', without keeping in mind which wall is lesser in length and which wall is greater in length.

- Lengths of long walls are measured on found 'out-to-out' and those of short walls as 'In-to-in.'

- Different quantities are calculated by multiplying the length by the breadth and height of the wall.

- The same rule applies to the excavation in foundation, to concrete bed in foundation, D.P.C, masonry in foundation and super structure etc.

- For symmetrical footing on either side, the center line remains same for super structure, foundation and plinth. So, the simple method is to find out the centre-to-centre lengths of long walls and short walls from the plan.

- Long wall length out-to-out:

Long wall length = center to center length + half breadth on one side
+ half breadth on other side.

= center to center length + one breadth.

- Short wall length in-to-in:

Short wall length = center to center length − one breadth.

- This method can also be worked out in a quicker way; as follows:

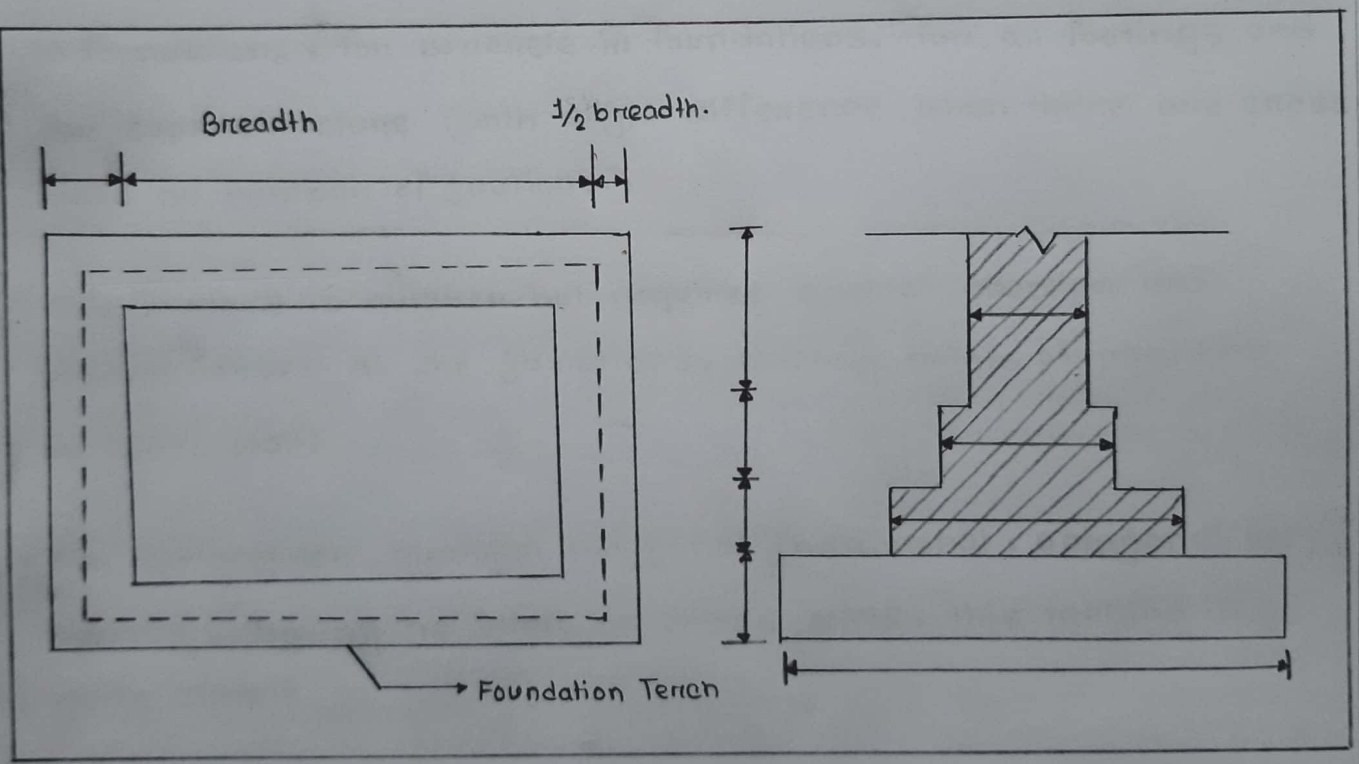
(a) For long walls:

- First of all, find the length of the foundation trech of the long wall 'out-to-out' in the same manner as explained above.
- The length of the foundation concrete is the same.
- For the length of the first footing or first step of the brick wall, subtract two offsets (2×6" = 12") in the foundation concrete from the length of the trech or concrete.

- For the second footing subtract from the length of the 1st footing two offsets ($2 \times 2'25'' = 4'5''$), for 3rd footing subtract from the length of the 2nd footing 2 offsets ($4'5''$) and in this way the long walls upto the super structure.

(b) For short walls:

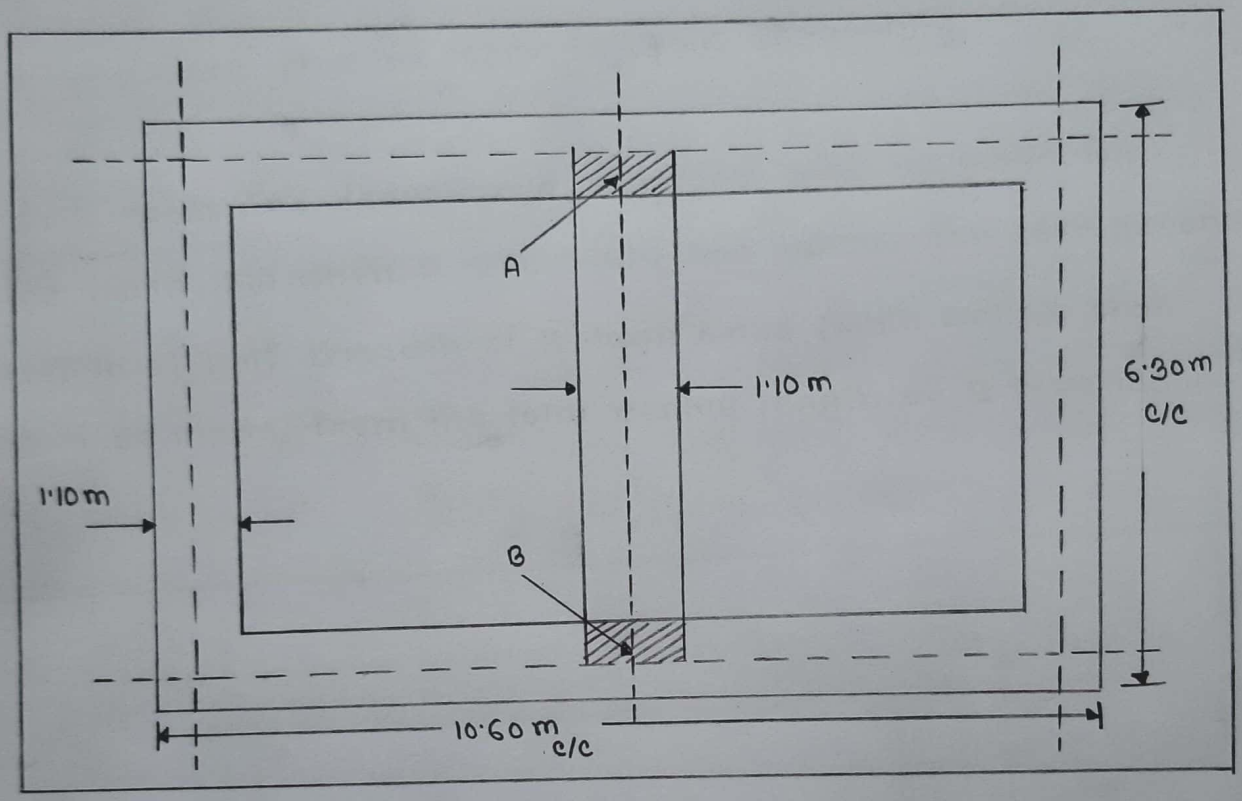
Follow the same method but instead of subtracing add two offsets to get the corresponding lengths in-to-in.



2) Centre line method:

- In this method, total length of centre lines of walls, long and short has to be found out.
- Find the total length of centre lines of walls same type, having same type of foundations and footings and then find the quantities by multiplying the total centre length by the respective breadth and the height.
- In this method, the length will remain the same for excavation in foundations, for concrete in foundations, for all footings and for superstructure (with slight difference when there are cross walls or number of juctions.)
- This method is quicker but requires special attention and considerations at the junctions, meeting points of partition or cross walls.
- For rectangular, circular polygonal (hexagonal, octagonal etc) buildings having no inter or cross walls, this method is quite simple.
- For buildings having cross or partition walls, for every junction, half breadth of the respective item or footing is to be deducted from the total centre length.

- Thus in the case of a building with one partition wall or cross wall having two junctions, deduct one breath of the respective item of work from the total centre length.



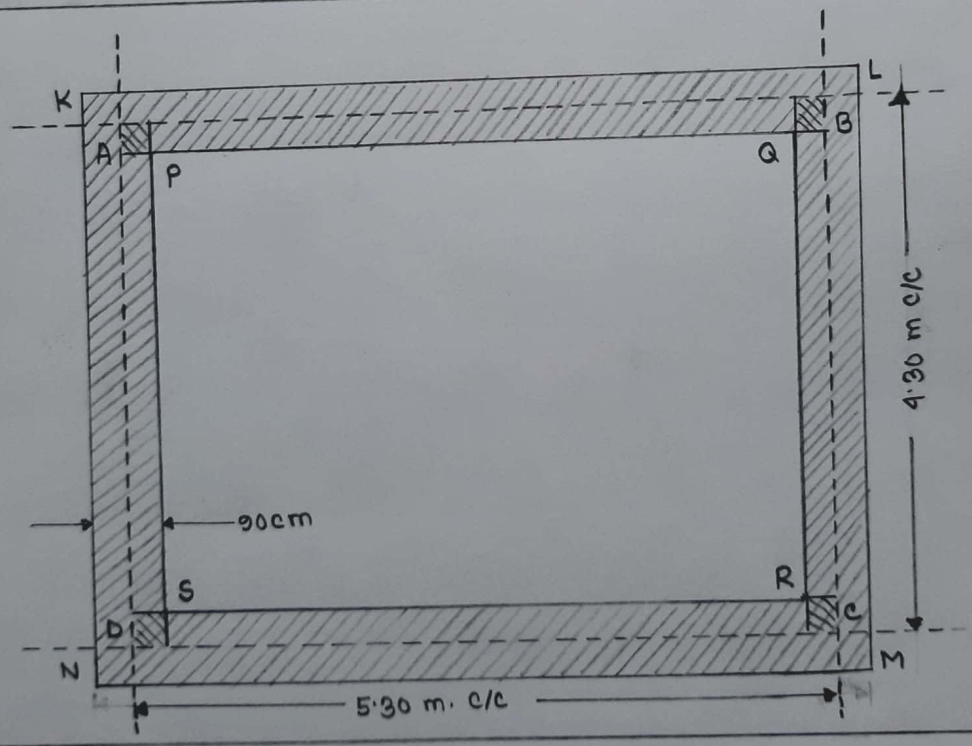
- For buildings having different types of walls, each set of walls shall have to be dealt separately.

- 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 this separately, and so on.

- Suppose the outer walls (main walls) are of A type and inner cross walls are of B type.

- Then all A type walls shall be taken jointly first, and then all B type walls shall be taken together separately.

- In such cases, no deduction of any kind need be made for A type walls, but when B type walls are taken, for each junction deduction of half breadth of A type walls (main walls) shall have to be made from the total centre length of B type walls.



- At corners of the building where two walls are meeting, no subtraction or addition is required.

- In the figure, the double cross-hatched areas marked P, Q, R, S come twice, while blank areas, A, B, C, D do not come at all, but these portions being equal in magnitude, we get the correct quantity.

Example of Methods of Estimation:

Prepare a detailed estimate of part of a wall of a building from the given plan and section and general specification.

General Specifications:

(1) Foundation concrete shall be of lime concrete.

(2) Foundation and plinth shall be of 1st class brick work in lime mortar.

(3) Damp proof course – 2·5 cm C.C. 1:1·5:3 with water proofing compound.

(4) Superstructure – 1st class brick work in lime mortar.

(5) Wall finishing – Inside wall 12 mm cement plastered 1:6 and white washed coats.

Solution:

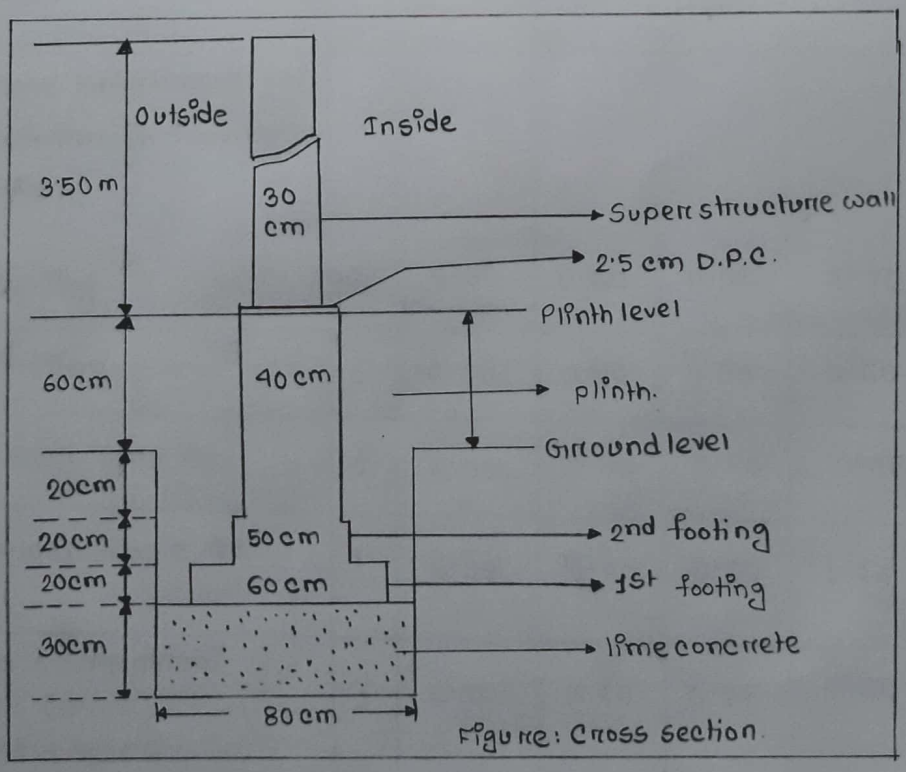


Figure: Cross section

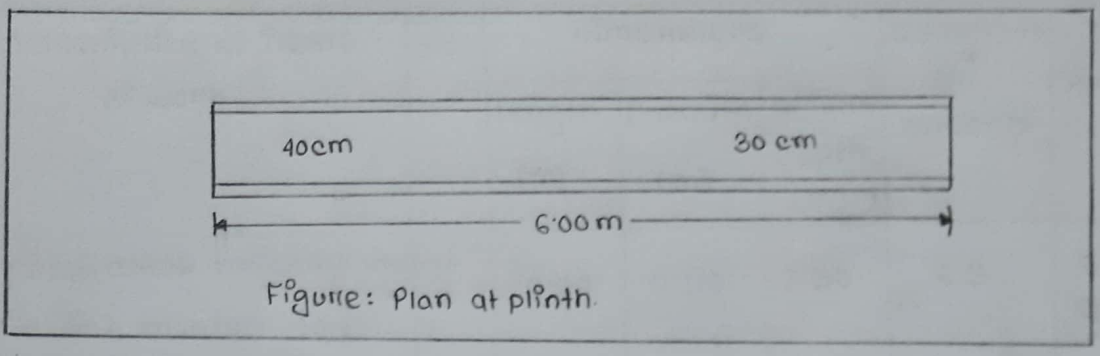


Figure: Plan at plinth

Details of measurement and calculation of quantities:

Item No.	Description of items of work	No.	Dimensions			Quantities or contents	Total Quantities
			Length (m)	Breadth (m)	Height/ Depth (m)		
1.	Earthwork in excavation in foundation.	1	6.00	0.80	0.90	4.32	4.32 cu m.
2.	Lime concrete in foundation.	1	6.00	0.80	0.30	1.44	1.44 cu m.
3.	1st class brickwork in lime mortar in foundation and plinth.						
	1st footing	1	6.00	0.60	0.20	0.72	
	2nd footing	1	6.00	0.50	0.20	0.60	3.24 cu m
	Plinth wall upto GL.	1	6.00	0.40	0.20	0.48	
	Plinth wall above GL.	1	6.00	0.40	0.60	1.44	
4.	2.5 cm Damp proof course (D.P.C) C.C 1 : 1 ½ : 3.	1	6.00	0.40	0.25	0.60	0.60 cu m.

Item No.	Description of items of work	No.	Dimensions			Quantities or contents	Total quantities
			Length (m)	Breadth (m)	Height/ Depth (m)		
5.	First class brickwork in lime mortar for superstructure.	1	6·00	0·30	3·50	6·3	6·3 cu m.
6.	12 mm plaster of cement sand 1:6 – Inside	1	6·00	–	3·50	21·0	46·38 sq. m.
	Outside (including 13 cm below GL.)	1	6·00	–	4·23	25·38	
7.	White washing 3 coats (inside)	1	6·00	–	3·50	21·0	21·0 sq. m.
8.	Colour washing 2 coats over one coat of white washing (outside above GL.)	1	6·00	–	4·10	24·6	24·6 sq. m.

Estimate the quantities of brickwork and plastering required in a wall 4m long, 3m high and 30 cm thick. Also calculate the cost if the rate of the brickwork is 320 taka per cu m and of plastering is 8·5 per sq.m.

Solution:

Quantity of brickwork = L×B×H

= 4m × 3m × 0·30m = 3·6 cu.m.

Quantity of plastering (two faces) = 2×L×H

= 2×4m × 3m = 24 sq. m.

Cost of brick work = 3·6 × 320 = 1152 taka.

Cost of plastering = 24 × 8·5 = 204 taka.

Total cost = 1152 + 204 = 1356 taka.

(Ans)