Reference Books:

1. **Estimating And Costing in Civil Engineering (Theory & Practice)**

- **B.N. Dutta**

ESTIMATION

Estimation is the scientific way of working out the approximate cost of an engineering project before 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 & 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 then 5 to 10 % from its approximate cost estimate, provided there are no unusual, unforeseen circumstances.

Actual Cost:

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

NEED FOR ESTIMATE

1. It help to work out 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 and after the its execution for 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 of an ordinary house or office and it may also be of a Dam, Tunnel, Multistory building, Airport, Bridge, or a Road, already in operation. Each of these works requires totally different construction techniques, type 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, lightening, and controlling efforts, etc.

6. The source of availability 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 surveying.
- He/She must thoroughly understand the drawings of the structure, for which he is going to prepare an estimate.
- He/She 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 specifications.

A good estimator of construction costs should possess 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 localities, 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 estimation.

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 building 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, and
- Investigate general efficiency of local workman.

Following requirement are necessary for preparing an estimate.

a) Drawings like plan, elevation and sections of important points.

b) Detailed specifications about workmanship & properties of materials etc.

c) Standard schedule of rates of the current year.

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

Data required to prepare an estimate:

1. Drawings i.e. Plans, elevations, sections etc.

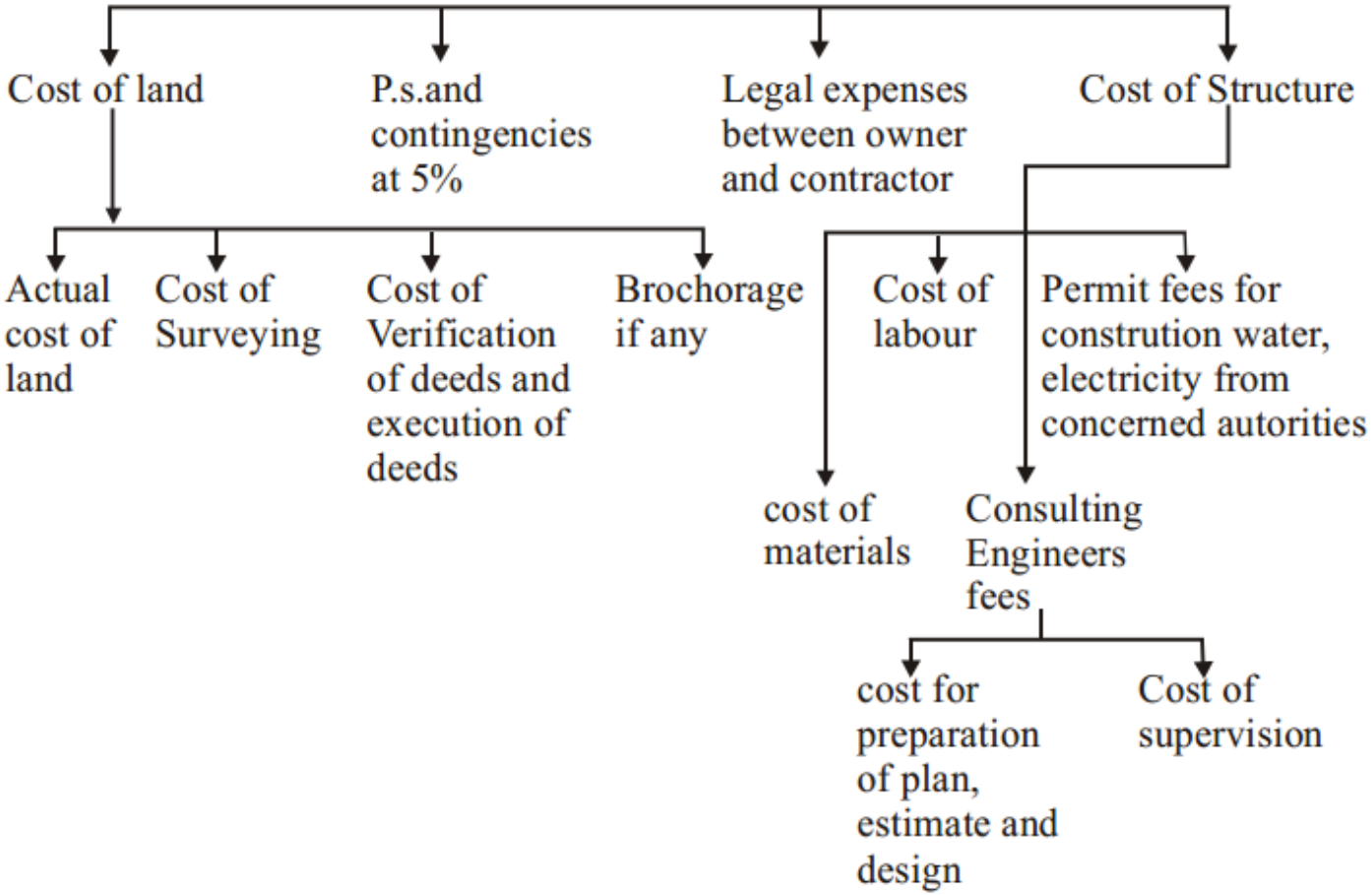
2. Specifications.

3. Rates.

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 are included.

The Complete Estimate



LUMPSUM:

While preparing an estimate, it is not possible to workout in detail in case of petty items. Items other than civil engineering such items are called lumpsum items or simply L.S.Items.

The following are some of L.S. Items in the estimate.

1. Water supply and sanitary arrangements.
2. Electrical installations like meter, motor, etc.,
3. Architectural features.
4. Contingencies and unforeseen items.

In general, certain percentage on the cost of estimation is allotted for the above L.S.Items Even if sub estimates prepared or at the end of execution of work, the actual cost should not exceed the L.S. amounts provided in the main estimate

Work charged establishment:

During the construction of a project considerable number of skilled supervisors, work assistance, watch men etc. are employed on temporary basis. The salaries of these persons are drawn from the L.S. amount allotted towards the work charged establishment. That is, establishment which is charged directly to work. an L.S. amount of 1½ to 2% of the estimated cost is provided towards the work charge establishment.

UNITS OF MEASUREMENTS:

The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor and also. The principle of units of measurements normally consists the following:

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 metres (RM)

c) Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc., are expressed in square meters.

d) Works consists cubical contents which involve volume like earth work, cement concrete, Masonry etc are expressed in Cubic metres.

Sl. No.	Particulas of item	Units of Measurement	Units of payment
I	**Earth work:**		
	1. Earth work in Excavation	cum	Per%cum
	2. Earthwork in fillingin founda-tion trenches	cum	Per%cum
	3. Earth work in filling in plinth	cum	Per%cum
II	**Concrete:**		
	1. Lime concretre in foundation	cum	percum
	2. Cement concrete in Lintels	cum	percum
	3. R.C.C.in slab	cum	percum
	4. C.C. or R.C.C. Chujja, Sun-shade	cum	percum
	5. L.C. in roof terracing (thickness specified)	sqm	persqm

	6. Cement concrete bed	cum	per cum
	7. R.C. Sunshade (Specified Width & Hight	cum	1rm
III	**Damp ProofCource (D.P.C)**		
	(Thickness should be mentioned)	sqm	persqm
IV	**Brick work:**		
	1. Brickwork in foundation	cum	percum
	2. Brick work in plinth	cum	percum
	3. Brick work in super structure	cum	percum
	4. Thin partition walls	sqm	percum
	5. Brick work in arches	cum	percum
	6. Reinforced brick work (R.B.Work)	cum	percum

V	**Stone Work:**		
	Stone masonry	cum	percum
VI	**Wood work:**		
	1. Door sand windows frames or chowkhats, rafters beams	cum	percum
	2. Shutters of doors and windows (thickness specified)	sqm	persqm
	3. Doors and windows fittings (like hinges, tower bolts, sliding bolts, handles)	Number	per number
VII	**Steel work**		
	1. Steel reinforcement bars etc in R.C.C. and R.B.work. quintal	Quintal	per quintal
	2. Bending, binding of steel Reinforcement	Quintal	per quintal
	3. Rivets, bolts, & nuts, Anchor bolts, Lewis bolts, Holding down bolts.	Quintal	per quintal
	4. Iron hold fasts	Quintal	per quintal
	5. Iron railing (height and types specified)	Quintal	per quintal
	6. Iron grills	sqm	per sqm

VIII	**Roofing**		
	1. R.C.C. and R.B.Slab roof (excluding steel)	cum	per cum
	2. L.C. roof over and inclusive of tiles or brick or stone slab etc (thickness specified)	sqm	per sqm
	3. Centering and shuttering form work	sqm	per sqm
	4. A.C.Sheet roofing	sqm	per sqm
IX	**Plastering, points&finishing**		
	1. Plastering-Cement or Lime Mortar (thickness and pro-portion specified)	sqm	per sqm
	2. Pointing	sqm	per sqm
	3. White washing, colour washing, cement wash (number of coats specified)	sqm	per sqm
	4. Distempering (number of coats specified)	sqm	per sqm
	5. Painting, vamishing (number of coats specified)	sqm	per sqm

X	**Flooring**		
	1. 25mm cement concrete over 75mm lime concrete floor (including L.C.)	sqm	per sqm
	2. 25mm or 40mm C.C. floor	sqm	per sqm
	3. Doors and window sills (C.C. or cement mortar plain)	sqm	per sqm
XI	**Rain water pipe /Plain pipe**	1RM	per RM
XII	**Steel wooden trusses**	1No	per 1No
XIII	**Glass pannels(supply)**	sqm	per sqm
XIV	**Fixing of glass panels or cleaning**	No	per no.

Types of estimate:

1) Preliminary estimate, Approximate or Abstract or Rough cost estimate
2) Plinth area estimate
3) Cube rate estimate or cubical content estimate
4) Detailed estimate or Item rate estimate
5) Approximate quantity method estimate
6) Revised estimate
7) Supplementary estimate
8) Supplementary and Revised estimate
9) Annual repair or Maintenance Estimate (A.R or A. M. estimate)

PRELIMINARY ESTIMATE

Preliminary Estimate is prepared by various ways for different structures as mentioned below :

- Buildings
  - Per Unit Basis – Per student for schools and hostels, per class room for schools, per bed for hospitals, per seat for cinema and theatre halls, per tenement for residential buildings.
  - Plinth area basis
  - Cubic content basis
  - Appx. Quantity method
- Roads and Highways – Per km basis depending upon nature of road, width and thickness of metalling.
- Irrigation Channels
  - Per km basis
  - Per hectare basis (Area of land commanded)

PRELIMINARY ESTIMATE (Ctd.)

- Bridges and Culverts – Per running meter of span depending upon type of structure, type and depth of foundation.
- Sewerage and Water Supply Project
  - Per head of population served
  - Per hectare basis (Area covered)
- Over Head water Tank – Per liter or per gallon of tank depending upon type of structure and height of tank.

PLINTH AREA ESTIMATE (P.A. ESTIMATE)

- P.A. is approximate estimate
- Plinth area should be calculated for covered area by taking external dimensions of the building at the floor level
- Courtyard and other open area should not be included
- For multi storeyed building Plinth Area for each storey is determined separately.
- Approximate total plinth area may be calculated by adding 30 to 40% of the already calculated area for walls, circulation and waste etc.
- Plinth area rate is known from cost of similar building in the locality.

CUBE RATE ESTIMATE

- Cube rate estimate is again approximate estimate
- Cubical content of the building is determined by multiplying length, breadth and height of the building.
- External length and breadth at the floor level are calculated for the purpose
- Height should be taken from the floor level to the top of roof.
- For multi storeyed building height is taken from floor level of one storey to top of next higher floor.
- Cube rate estimate is more accurate as compared to the plinth area estimate.

APPROXIMATE QUANTITY METHOD ESTIMATE

- Structure divided into two parts – (i) Foundation including plinth (ii) Superstructure
- Total length of walls is found out.
- To find running meter rate of foundation, appx. quantities of various items are calculated per running meter
- Similarly for superstructure appx. Quantities of brickwork, roof, flooring etc is calculated per running meter.

DETAILED ESTIMATE

- It is the accurate estimate prepared by working out quantities of each items of work.
- It is prepared in two stages –
  - Details of measurements and calculation of quantities.
  - Abstract of estimated cost – 3% to 5% of estimated cost is added to cover miscellaneous expenditure
- Detailed estimate is prepared work-wise.
- Detailed estimate consists of –
  - Report
  - General Specifications
  - Detailed specifications
  - Drawings
  - Calculation and designs
  - Analysis of rates
- Detailed estimate is prepared for technical sanction, for arranging contract and for execution of project.

REVISED ESTIMATE

- Revised estimate is prepared when original sanctioned estimate is likely to exceed more than 5%.
- When expenditure on work is likely to exceed amount of administrative sanction by more than 10%
- When there are material deviation from original proposal even though cost may be met from sanctioned cost.
- It is accompanied by comparative statement showing variations in each item of works and reason for the same.

Methods of Estimation

Example 1: Estimate the quantities of brickwork and plastering required in a wall 4 m long, 3 m high and 30 cm thick. Calculate also the cost if the rate of the brick work is 320 taka per cu m and of plastering is 8.5 per sq m.

Solution:

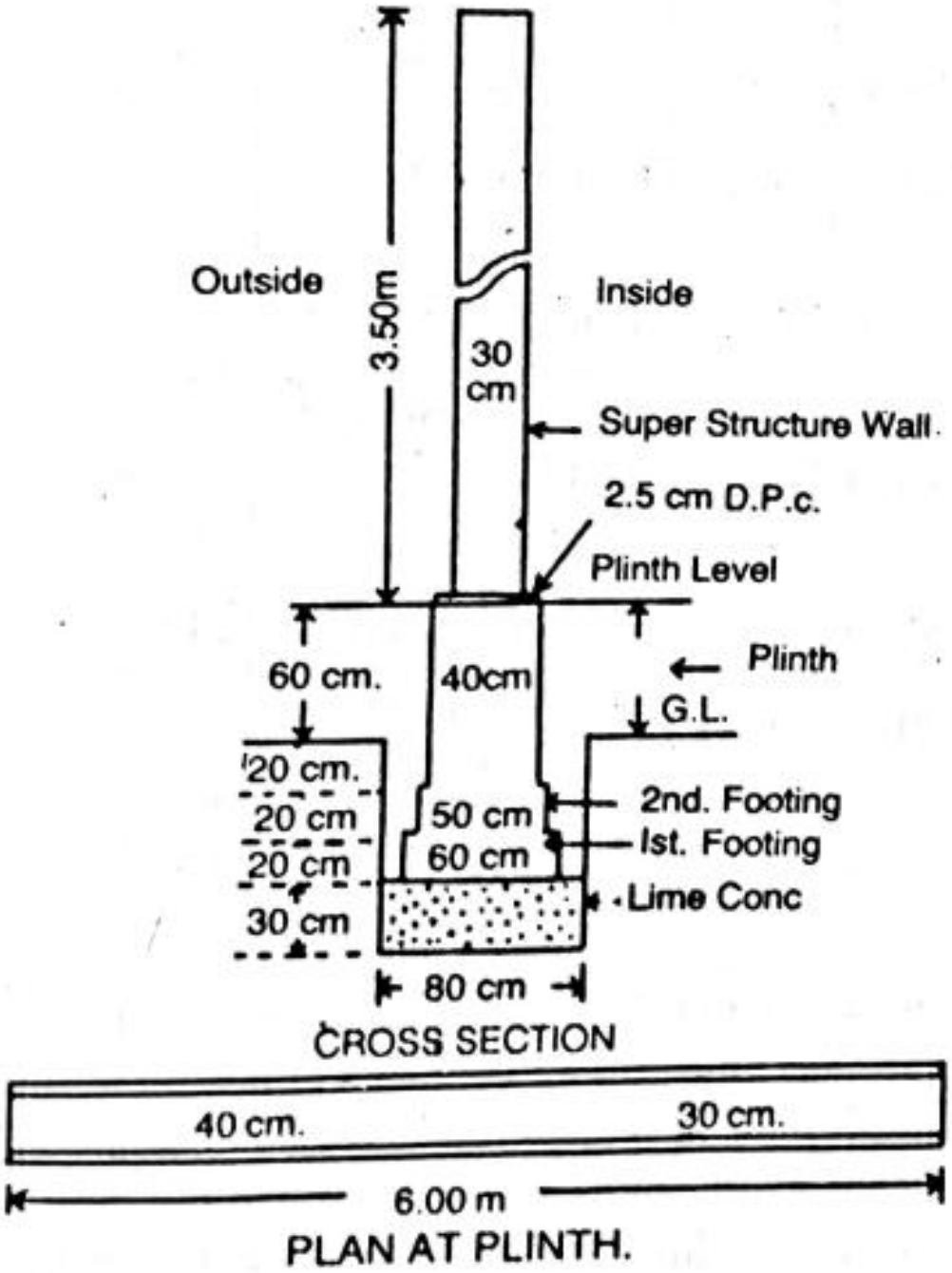
Quantity of brickwork = L x B x H = 4m x 3m x 0.30m = 3.6 cu m
Quantity of plastering (two faces) = 2 x L x H = 2 x 4m x 3m = 24 sq m
Cost of brick work = 3.6 x 320 = 1152 taka
Cost of plastering = 24 x 8.5 = 204 taka
Total cost = 1152 + 204 = 1356 taka

Example 2:

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.cc 1: 1.5: 3 with water proofing compound
4. Superstructure- 1st class brickwork in lime mortar
5. Wall finishing – Inside wall 12 mm Cement plastered 1: 6 and white washed 3 coats


Outside
3.50m
Inside
30 cm
Super Structure Wall
2.5 cm D.P.c.
Plinth Level
60 cm.
40cm
Plinth
G.L.
20 cm.
20 cm
20 cm
30 cm
50 cm
60 cm
2nd. Footing
Ist. Footing
Lime Conc
80 cm
CROSS SECTION
40 cm.
30 cm.
6.00 m
PLAN AT PLINTH.

DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 2)

Item No.	Description of items of work	No.	Dimensions			Quantities or Contents	Total quantities
			Length	Breadth	Ht. or Depth		
1.	**Earthwork** in excavation in foundation ...	1	6.00 m	.80 m	.90 m	4.32	4.32 cu m
2.	**Lime concrete** in foundation ...	1	6.00 m	.80 m	.30 m	1.44	1.44 cu m
3.	**1st class brickwork** in lime mortar in foundation and plinth						
	1st footing ...	1	6.00 m	.60 m	.20 m	.72	
	2nd footing ...	1	6.00 m	.50 m	.20 m	.60	
	Plinth wall up to G.L. ...	1	6.00 m	.40 m	.20 m	.48	3.24 cu m
	Plinth wall above G.L. ...	1	6.00 m	.40 m	.60 m	1.44	

(Contd.)

Item No.	Description of items of work	No.	Dimensions			Quantities or Contents	Total quantities
			Length	Breadth	Ht. or Depth		
4.	**2.5 cm Damp proof course** (D.P.C.) c.c.1 : 1½ : 3 ...	1	6.00 m	.40 m	—	2.4	2.4 sq.m
5.	**First class Brickwork** in lime mortar for superstructure ...	1	6.00 m	.30 m	3.50 m	6.3	6.3 cu m
6.	**12 mm plaster** of Cement sand 1:6 —						
	Inside	1	6.00 m	—	3.50 m	21.0	46.2 sq m
	Outside including 13 cm below G.L. ...	1	6.00 m	—	4.20 m	25.2	
7.	**White washing** 3 coats (inside) ...	1	6.00 m	—	3.50 m	21.0	21.0 sq m
8.	**Colour washing** 2 coats over one coat of white washing (outside above G.L.) ...	1	6.00 m	—	4.10 m	24.6	24.6 sq m

Pls. Write upto this

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 superstructure may be estimated by either of the two methods:

(1) SEPARATE OR INDIVIDUAL WALL METHOD

(2) CENTER LINE METHOD

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 or 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 the 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.

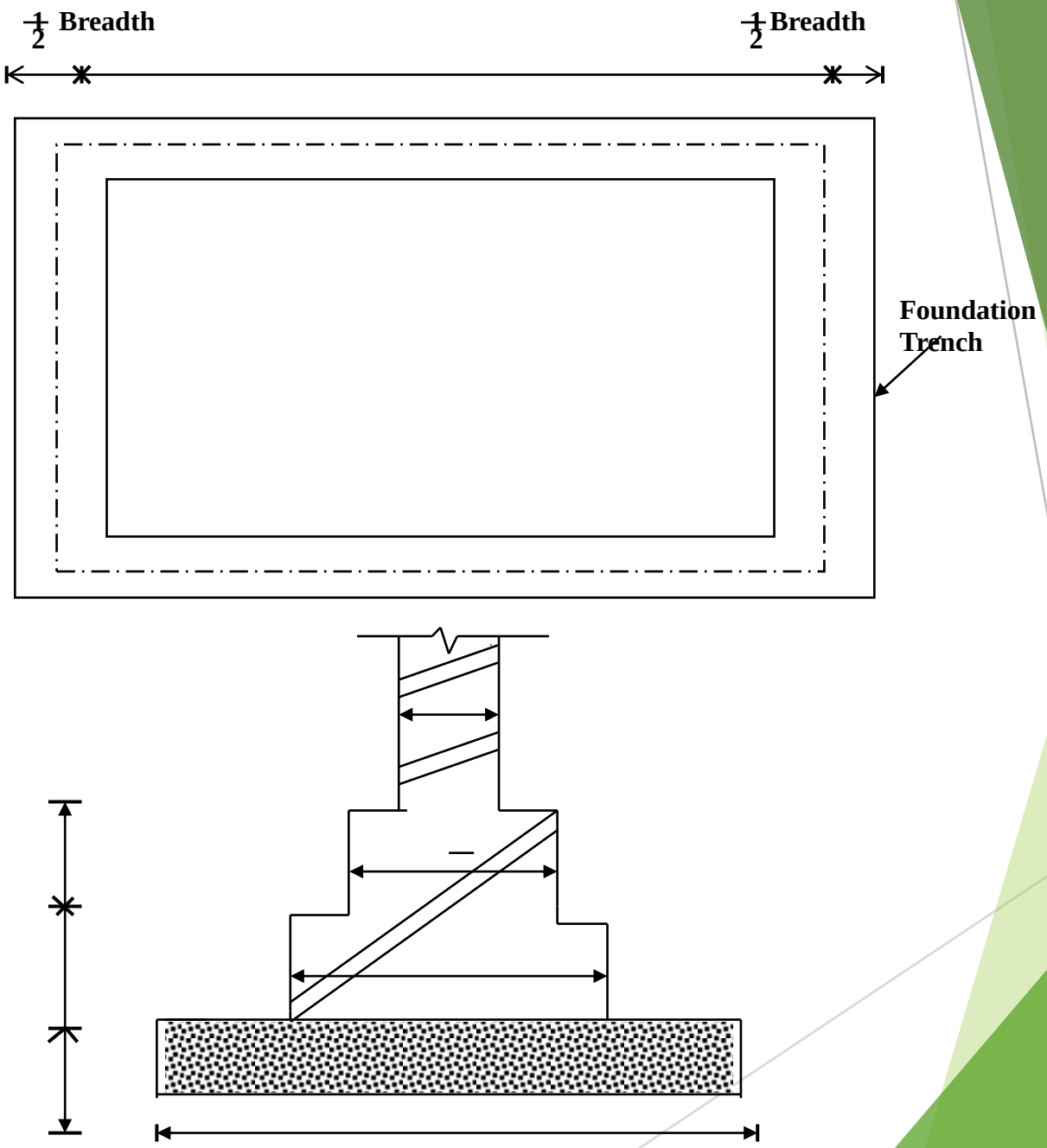
SEPARATE OR INDIVIDUAL WALLS METHOD

- 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**

  = Center to center length + half breadth on one Side + half breadth on other side.

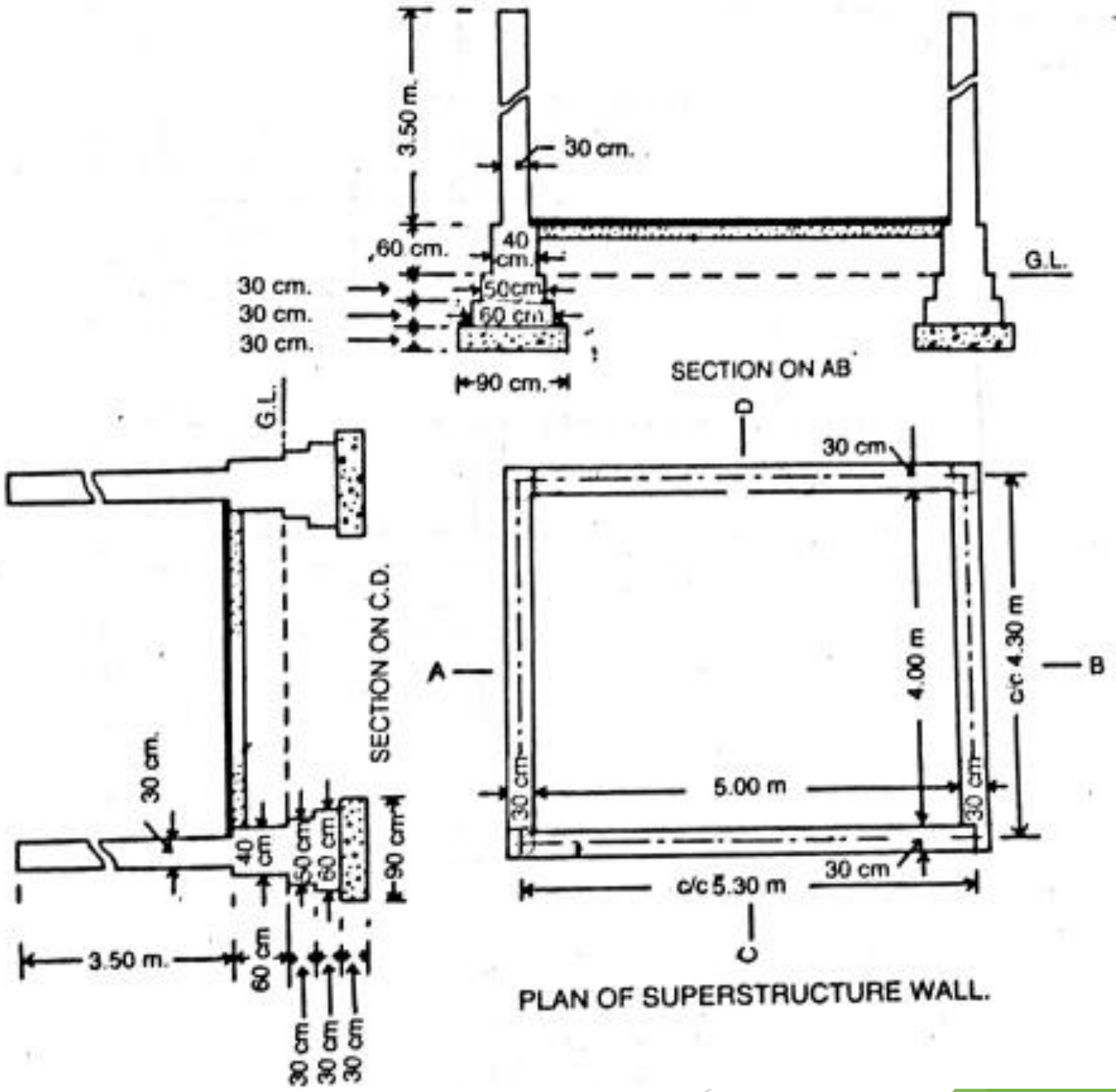
  = Center to center length + one breadth

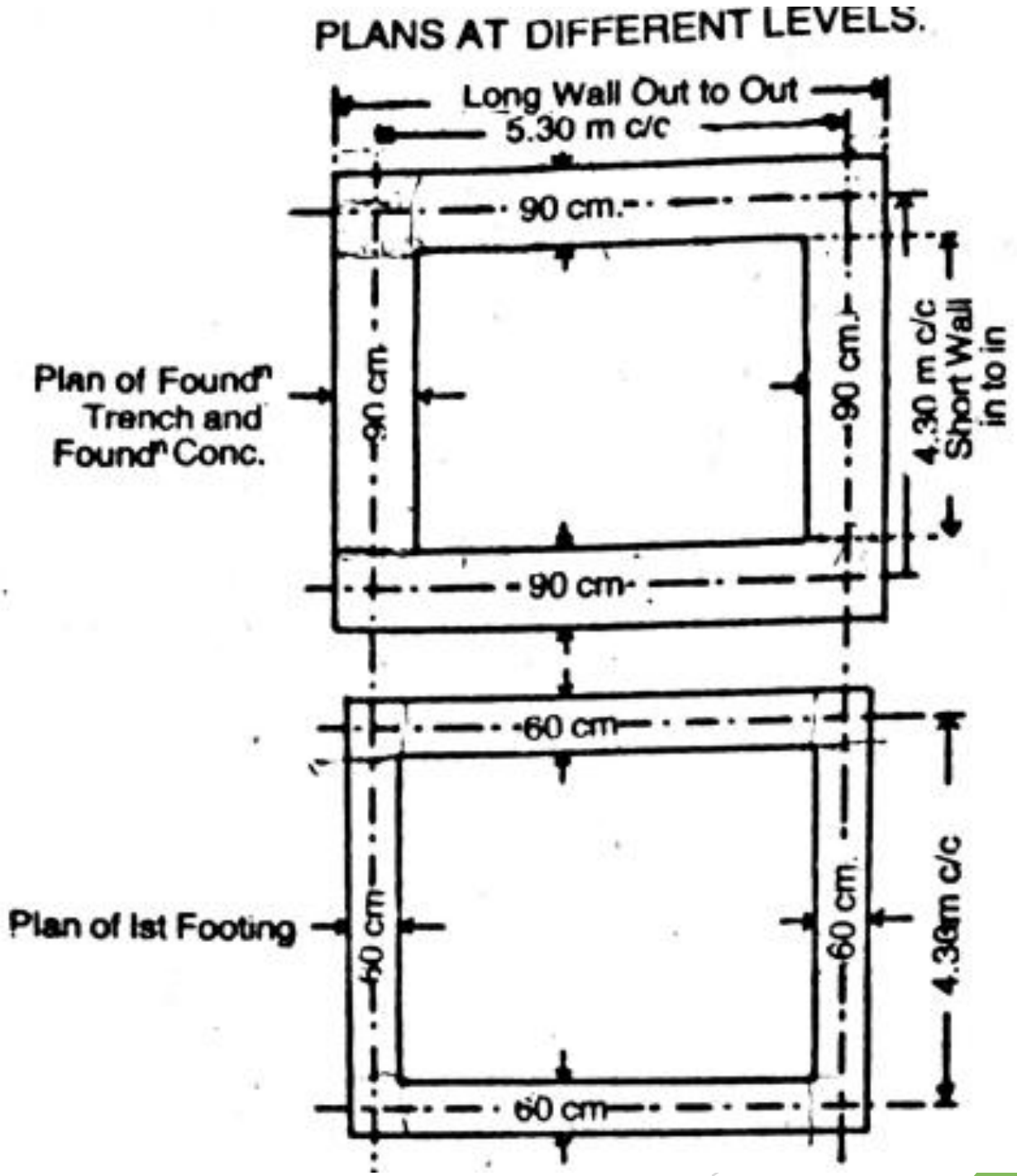
- **Short wall length in-to-in** = Center to Center length - one breadth.

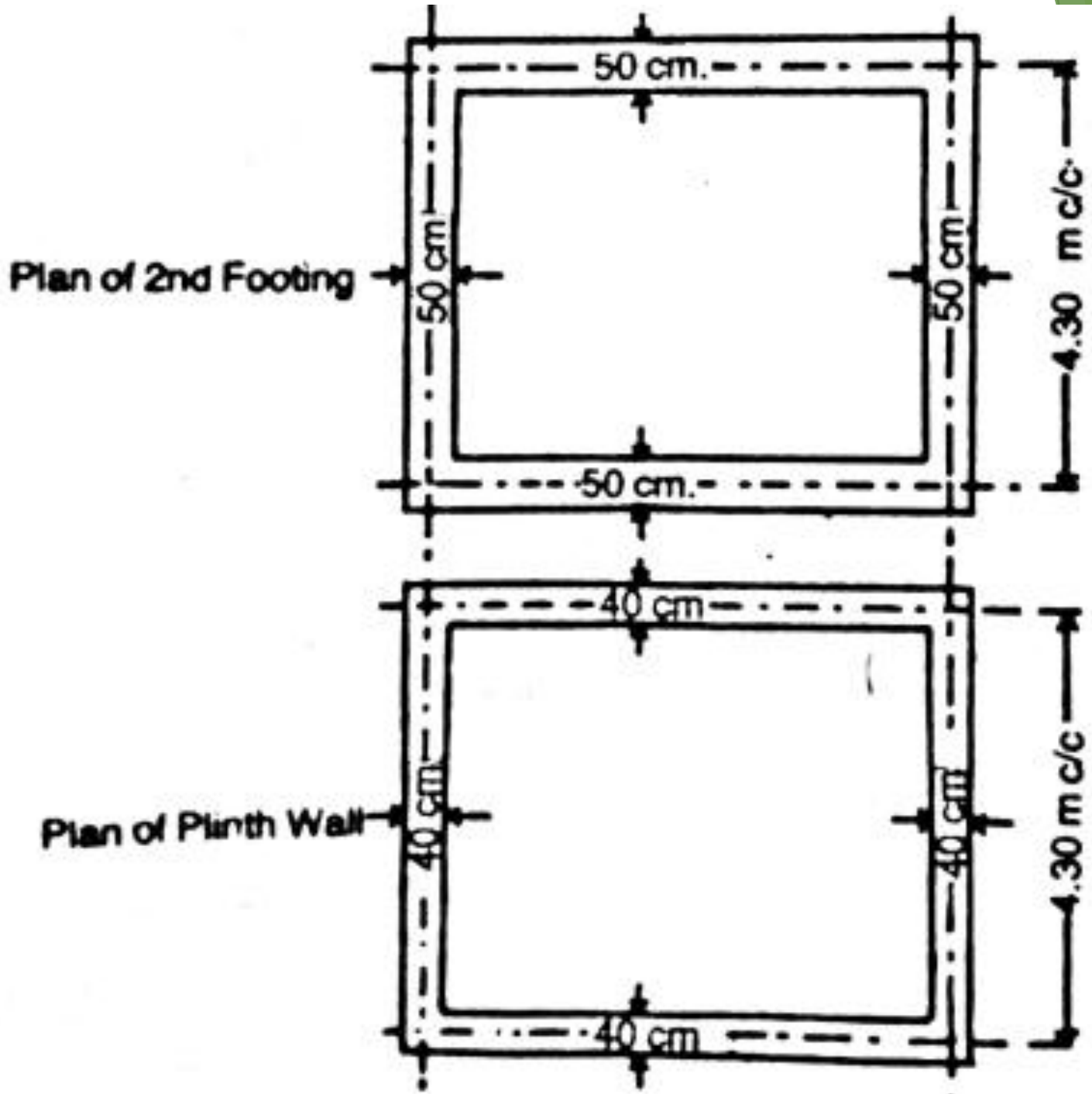

1/2 Breadth
1/2 Breadth
Foundation Trench

Example 3(a). — Fig. 2-3, the plan represents the plan of superstructure wall of a single room building of 5 m × 4 m, and Sections represent the cross-sections of the walls with foundation. Estimate the quantities of —

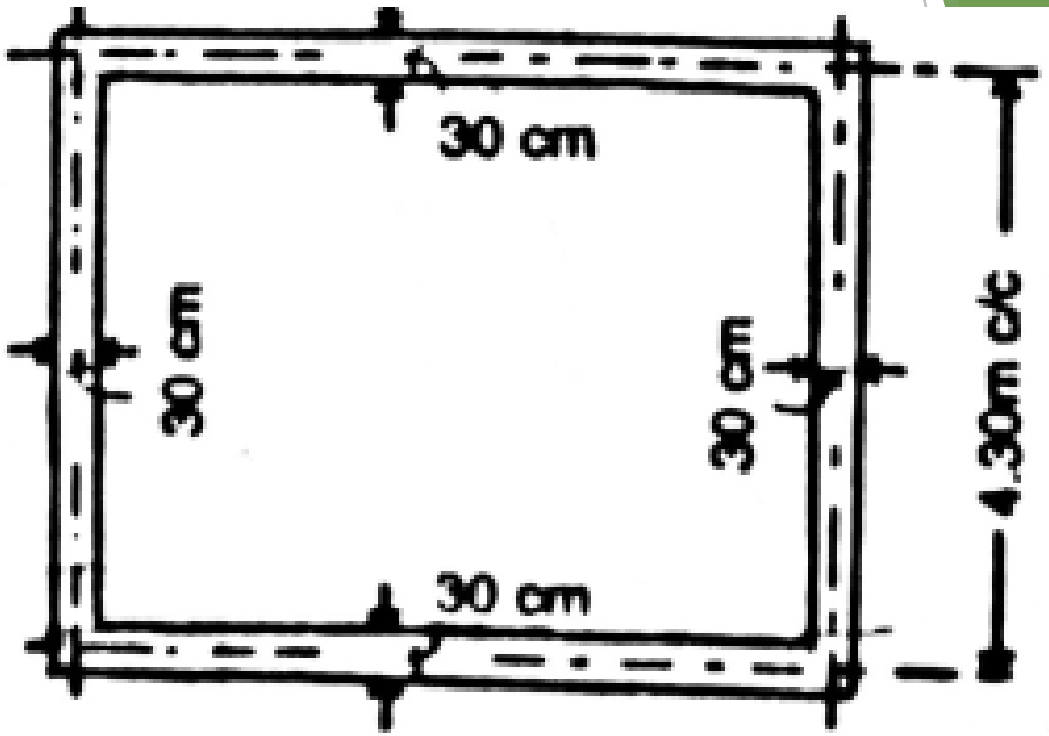
(1) Earthwork in excavation in foundation, (2) Concrete in foundation, (3) Brickwork in foundation and plinth and (4) Brickwork in superstructure.


3.50 m.
30 cm.
60 cm.
40 cm.
30 cm.
30 cm.
30 cm.
50cm
60 cm
G.L.
90 cm.
SECTION ON AB
G.L.
SECTION ON C.D.
30 cm.
40 cm
50 cm
60 cm
90 cm
3.50 m.
60 cm
30 cm
30 cm
30 cm
D
30 cm
A
B
4.00 m
c/c 4.30 m
30 cm
5.00 m
30 cm
30 cm
c/c 5.30 m
C
PLAN OF SUPERSTRUCTURE WALL.


PLANS AT DIFFERENT LEVELS.
Long Wall Out to Out
5.30 m c/c
90 cm.
90 cm.
90 cm.
4.30 m c/c
Short Wall
in to in
Plan of Found^n
Trench and
Found^n Conc.
90 cm
60 cm
60 cm.
60 cm.
4.30m c/c
Plan of Ist Footing
60 cm


Plan of 2nd Footing
50 cm.
50 cm
50 cm
50 cm.
4.30 m c/c
Plan of Plinth Wall
40 cm
40 cm
40 cm
40 cm
4.30 m c/c

Plan of Super Structure Wall



DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES (Ex. 3a)

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantity	Explanatory note
1.	**Earthwork in excavation in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.90 m	10.04	Length = 5.30 + .90 = 6.20 m
	Short walls ...	2	3.40 m	.90 m	.90 m	5.51	Breadth = 4.30 – .90 = 3.40 m
					Total	15.55 cu m	
2.	**Concrete in foundation —**						
	Long walls ...	2	6.20 m	.90 m	.30 m	3.35	Length same as for excavation
	Short walls ...	2	3.40 m	.90 m	.30 m	1.83	Quantity = $^1/_3$ of excavation
					Total	5.18 cu m	

3.	**Brickwork in foundation and plinth —**						
	Long walls —						
	1st footing ...	2	5.90 m	.60 m	.30 m	2.13	Length = 5.30 + .60 = 5.90 m
	2nd footing ...	2	5.80 m	.50 m	.30 m	1.74	Length = 5.30 + .50 = 5.80 m
	Plinth walls ...	2	5.70 m	.40 m	.60 m	2.74	Length = 5.30 + .40 = 5.70 m
	Short walls —						
	1st footing ...	2	3.70 m	.60 m	.30 m	1.33	Length = 4.30 – .60 = 3.70 m
	2nd footing ...	2	3.80 m	.50 m	.30 m	1.14	Length = 4.30 – .50 = 3.80 m
	Plinth walls ...	2	3.90 m	.40 m	.60 m	1.87	Length = 4.30 – .40 = 3.90 m
					Total	10.95 cu m	
4.	**Brickwork in superstructure**						
	Long walls ...	2	5.60 m	.30 m	3.50 m	11.76	Length = 5.30 + .30 = 5.60 m
	Short walls ...	2	4.00 m	.30 m	3.50 m	8.40	Length = 4.30 – .30 = 4.00 m
					Total	20.16 cu m	

Note : *The door openings, window openings, lintels, etc. shall have to be deducted from superstructure as usual.*