

# **CONTRACTS, SPECIFICATION AND ESTIMATION**

# CONTRACTS, SPECIFICATION AND ESTIMATION

## UNIT -1

**PRINCIPLES OF ESTIMATION:** Estimation, Terms used in estimation, Units of measurement, Geometry of various shapes, Approximate methods of estimation, Detailed methods of estimation, Cost of materials and labor.

**METHODS OF TAKING OUT QUANTITIES** – Center line method, Long wall and Short wall method. Preparation of detailed and abstract of estimates for the common Civil Engineering works. Introduction and an overview of the Schedule of Rates(SR) **06 Hours**

## UNIT – 2

**ESTIMATION OF CIVIL ENGINEERING STRUCTURES:** Typical RCC and Steel framed structures, masonry structures dealt in the present curriculum of the Civil Engineering Program. **14 Hours**

# CONTRACTS, SPECIFICATION AND ESTIMATION

## UNIT – 3

**EARTHWORK ESTIMATION:** Methods of earthwork estimation. Estimation of earthwork of roads by mid sectional area method, mean sectional area method, trapezoidal and Prismoidal formula methods.

**8 Hours**

## UNIT – 4

**SPECIFICATIONS & ANALYSIS OF RATES:** Introduction, Definition of specifications, Objectives of writing Specifications, Essentials in Specifications, General and Detailed specifications of common item of works in Buildings only.

**ANALYSIS OF RATES** – Definition, working out quantities and rates for the standard items of works **12 Hours**

# CONTRACTS, SPECIFICATION AND ESTIMATION

## UNIT-5

**CONTRACTS:** Definition of Contract, Objectives of Contract, Requirements of a valid Contract, Overview of Indian Contract Act 1872. Types of Engineering Contract with advantages, disadvantages and their suitability. Tender and Tender Documents, Tender and its Process, Breach of Contract and Arbitration. **08 Hours**

### Text books:

1. Estimating and Costing in Civil Engineering by B. N. Dutta, UBS Publishers and distributors Pvt. Ltd, New Delhi.
2. Estimating, Costing, Specification & Valuation In Civil Engineering By M Chakraborti.

# CONTRACTS, SPECIFICATION AND ESTIMATION

## Reference books:

1. Quantity Surveying-P. L. Basin, S. Chand: New Delhi.
2. Estimating & Specification – S.C. Rangwala: Charotar publishing house, Anand.
3. Text book of Estimating & Costing- G.S. Birde, Dhanpath Rai and sons : New Delhi.
4. A text book on Estimating, Costing and Accounts- D.D. Kohli and R.C. Kohli S. Chand : New Delhi.
5. Schedule of Rates published by Public Works Department.
6. E-learning resources.

## SEE paper pattern:

There are 7 questions. Students have to answer 5 questions. Unit2 and Unit 4 have choice. All questions should carry equal marks (20 marks for one full question). Each question should not have more than four subdivisions.

# ESTIMATION OR QUANTITY SURVEYING

The process of knowing well in advance the probable/anticipated/expected cost of engineering structure is called **ESTIMATION OR QUANTITY SURVEYING.**

# NEED FOR ESTIMATION

- Gives an idea of the cost of the structure.
- Helps to call for tenders for the work depending on the quantities of different items of work estimated.

# TECHNICAL TERMS

- **QUANTITY SURVEY**

- It is the schedule of all items of work in a building.
- Quantities are calculated from the drawing of the building.
- It gives quantities of work done in case of each items.

It means calculations of quantities of materials required to complete the work concerned.

# TECHNICAL TERMS

## • SPECIFICATIONS

- It gives the nature, quality and class of work, materials to be used in the various parts of work , quality of the material, their proportions, method of preparation, workmanship and description of execution of work are required.

### 2.0 EARTH WORK FOR BUILDINGS

2.1 KSRB 2-1 : Earthwork in surface excavation for levelling and lowering the ground **manually** (Other than foundation of buildings, culverts, road drains and trenches of pipe lines and cables) and removing the excavated stuff to a distance not exceeding 50m and lift-up to 1.5m, excavated surface levelled and neatly dressed, disposed earth to be levelled including breaking of clods and neatly dressed as per specifications. specification. No. KBS 2.1(a) / 2.3.1

2.1	KSRB 2-1.1: – do – Ordinary soil	Cum	249.00
2.2	KSRB 2-1.2: – do – Hard soil	Cum	349.00

# TECHNICAL TERMS

## • RATES

- The rates of various items of works, materials to be used in the construction and the wages of different categories of labor (skilled and unskilled) should be available for preparing an estimate.

### 2.0 EARTH WORK FOR BUILDINGS

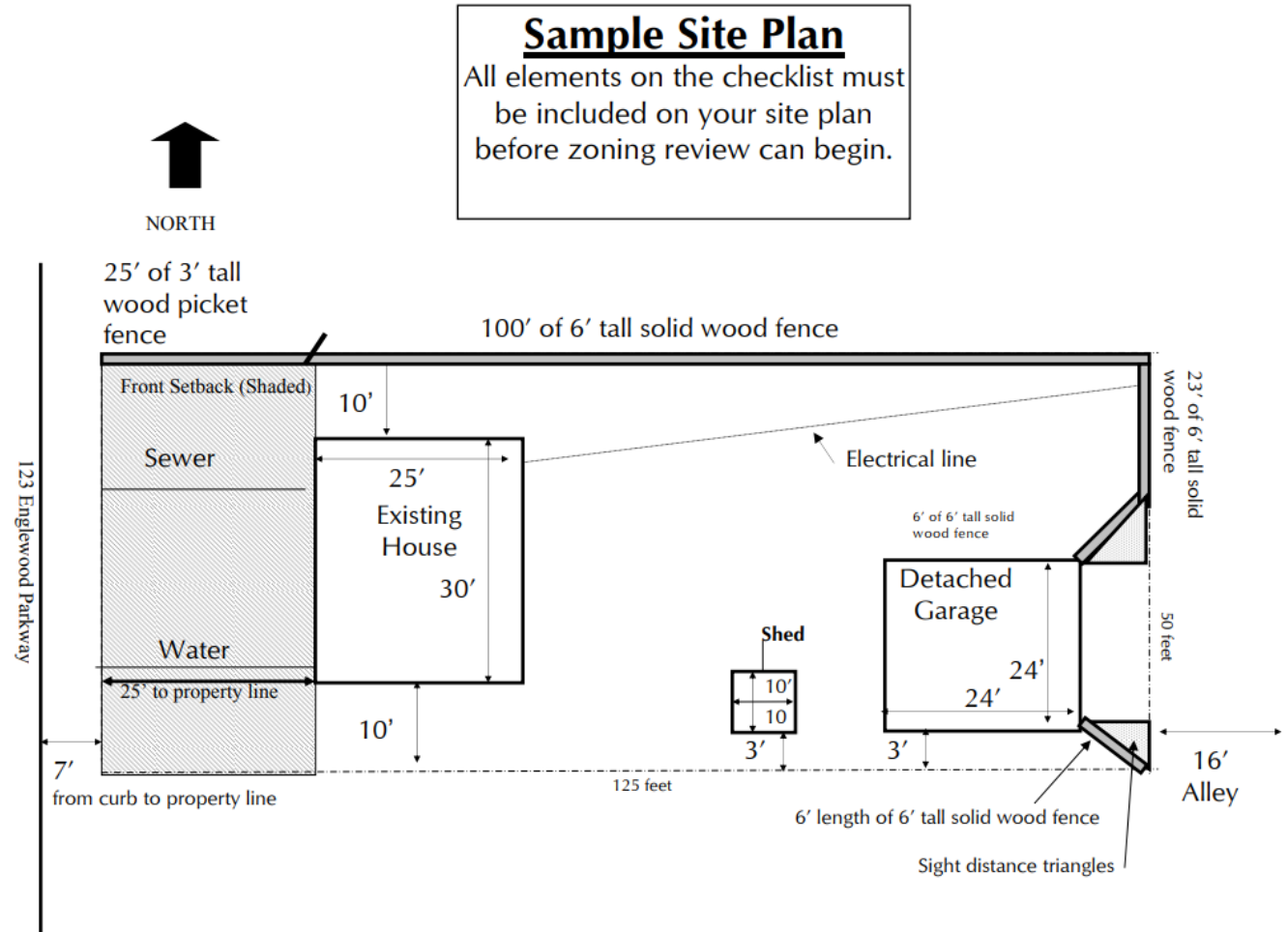
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2.1	KSRB 2-1.1: – do – Ordinary soil	Cum	249.00
2.2	KSRB 2-1.2: – do – Hard soil	Cum	349.00

# TECHNICAL TERMS

## • SITE PLAN

- It is the plan drawn for a particular construction showing its position with respect to approaching roads, main bazars, markets and other permanent features in a populated area.



<https://www.englewoodco.gov/home/showdocument?id=10014>



# TECHNICAL TERMS

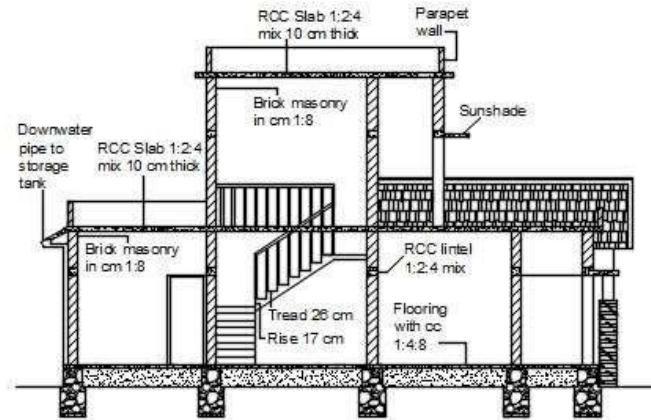
- **DETAILED PLAN**

- This plan indicates a plan of a construction drawn to a definite scale, showing all detailed information required for its execution.
- Various sections and elevations are clearly drawn on this plan.

# DETAILED PLAN



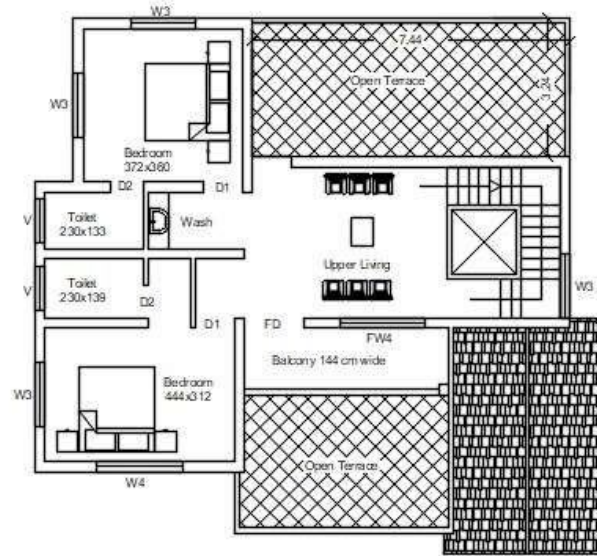
ELEVATION



SECTION ON AA



GROUND FLOOR PLAN



FIRST FLOOR PLAN

## PLINTH AREA DETAILS

GROUND FLOOR	- 128.00 Sqmt
PORCH AREA	- 19.77 Sqmt
FIRST FLOOR	- 87.09 Sqmt
TOTAL	- 234.86 Sqmt

## CARPET AREA DETAILS

GROUND FLOOR	- 100.43 Sqmt
FIRST FLOOR	- 58.45 Sqmt
TOTAL	- 158.88 Sqmt

TERRACE FLOOR AREA - 40.91 Sqmt

F.A.R - 0.24, COVERAGE 15.21%

FRONT DOOR	- 110X210
DOOR	- 90X210
DOOR TOILET	- 75X210
WINDOW 2	- 100X100
WINDOW 3	- 200X140
FW 4	- 200X190
VENTILATION	- 100X50

## SPECIFICATIONS

Foundation & Basement	- R.R in C.M 1:8
Plastering walls	- C.M 1:4, 12mm thick
plastering ceiling	- C.M 1:3, 12mm thick
Superstructure	- Brick in C.M 1:6
Roofing	- RCC 1:2:4

## SIGNATURE OF APPLICANT

## CERTIFICATE & SIGNATURE OF LICENCED ENGINEER

Certified that the site plan is prepared after verification of ownership document and the site and the measurement shown are found to be correct.

Also certified that the building plan is prepared in accordance with KPBR 2011

# GENERAL – ESTIMATION

- 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.

# GENERAL – ESTIMATION

- The following requirements are necessary for preparing an estimate.
  1. Drawings like plan, elevation and sections of important points.
  2. Detailed specifications about workmanship & properties of materials etc.
  3. Standard schedule of rates of the current year.

# BASIC SI UNITS

- Unit of Length – Metre (m)
- Unit of Mass – Kilogram (kg)
- Unit of Time – Second (s)
- Unit of Electric Current – Ampere (A)
- Unit of Thermodynamic Temperature – Kelvin (K)
- Unit of Luminous Intensity – Candela (cd.)

# UNITS OF MEASUREMENTS

- The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor.
- The principle of units of measurements normally consists the following:
  - Single units work like doors, windows, trusses etc., **is expressed in numbers (Nos).**
  - Works consists linear measurements involve length like fencing, hand rail, rain water pipes, cornice etc., **are expressed in running meters (RM or m)**

# UNITS OF MEASUREMENTS

- The principle of units of measurements normally consists the following:
  - Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc., and **are expressed in square meters (Sqm)**
  - Works consists cubical contents which involve volume like earth work, cement concrete, Masonry etc., are **expressed in Cubic metres (cum)**.

# RULES FOR MEASUREMENT

- The rules for measurement of each item are invariably described in IS- 1200.
- Few General rules are:
  - Measurement shall be made for finished item of work and description of each item shall include materials, transport, labor, fabrication tools and plant and all types of overheads for finishing the work in required shape, size and specification.
  - In booking, the order shall be in sequence of length, breadth and height or thickness.

# GENERAL – RULES FOR MEASUREMENT

- All works shall be measured subject to the following tolerances.
  - Linear measurement shall be measured to the nearest 0.01m.
  - Areas shall be measured to the nearest 0.01 sq.m
  - Cubic contents shall be worked-out to the nearest 0.01 cum
- Same type of work under different conditions and nature shall be measured separately under separate items.

# GENERAL – RULES FOR MEASUREMENT

- The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.
- In case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the heights shall be described:
  - From foundation to plinth level
  - From plinth level to first floor level
  - From First floor to second floor level and so on.

# REQUIREMENTS OF ESTIMATION AND COSTING

- Estimate gives 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.
- Estimate gives an idea of time required for the completion of the work.
- Estimate is required to invite the tenders and Quotations and to arrange contract.

# REQUIREMENTS OF ESTIMATION AND COSTING

- Estimate is also required to control the expenditure during the execution of work.
- Estimate decides whether the proposed plan matches the funds available or not.

# **SITE CONDITIONS AFFECTING THE OVERALL COST**

- Each type of work requires a different method of construction.
- Quality of labour and labour output varies in different localities.
- Weather conditions greatly affect the output and, hence, the overall cost.
- Ground conditions vary and change the method of construction.
- The source of availability of a sufficient supply of materials of good quality is also a factor.

# SITE CONDITIONS AFFECTING THE OVERALL COST

- The availability of construction machinery also affects the method of construction.
- Access to the site must be reasonable. If the access is poor, temporary roads may be constructed.

# PROCEDURE OF ESTIMATING OR METHOD OF ESTIMATING

- Preparing detailed estimate
- Calculating the rate of each unit of work
- Preparing abstract of estimate

# TYPES OF ESTIMATES

- There are two main types of estimates:
  - Rough/approximate cost estimate
  - Detailed estimate
- Depending on the purpose of estimate, some types of detailed estimate are as follows:
  - Contractor's estimate
  - Engineer's estimate
  - Progress estimate

# 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 are also included as Lump sum (L.S.) items.
  - Water supply and sanitary arrangements
  - Electrical installations like meter, motor, etc.,
  - Architectural features
  - 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 are prepared at the end of execution of work, the actual cost should not exceed the L.S. amounts provided in the main estimate.

# UNFORESEEN 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 unforeseen circumstances affecting the project.
- Hence, a certain allowance usually 3% to 5% of the total cost, is made in the estimation which will take care of all these items that are unforeseen or are overlooked and are known as "Contingencies".

# 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.
- L.S. amount of 1½ to 2% of the estimated cost is provided towards the work charged establishment.

# ROUGH/APPROXIMATE COST ESTIMATE

- Preliminary or approximate 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.

# ROUGH/APPROXIMATE COST ESTIMATE

- Various methods used for preparation of approximate estimates are:
  - Unit base method – For public buildings, cost/person (cost per capita) is used.
    - Hostel - cost per student
    - Hospital - Cost per bed
    - Hotel - Cost per Guest
  - Plinth area method – **Cost of construction = Plinth area x plinth area rate.**
  - Cubical contents method – More accurate than the other two methods generally used for multi-storeyed buildings
    - **Cost of construction = Total cubical contents (L\*B\*D) x Local cubic rate (Rate/unit volume)**

# EXAMPLE - 1

Prepare a rough-cost (preliminary) estimate of a residential building project with a total plinth area of the building - 1500 Sqm. Given that:

- Plinth Area Rate = ₹ 950.00 / Sqm
- Extra for special architectural treatment = 1.5% of the building cost.
- Extra for water supply and sanitary installations = 4% + 4% of the building cost.
- Extra for internal installations = 12% of the building cost
- Extra for Electric & gas services = 8% + 8% of building cost
- Contingencies 3% overall
- Supervision charges = 8% overall
- Design charges = 2% overall

# EXAMPLE - 1

# EXAMPLE - 1

Building cost – 1500sqm @ 950.00 per sqm = $1500 \times 950$	₹ 14,25,000.00
Special architectural treatment – 1.5% of the building cost = $14,25,000 \times (1.5/100) =$	₹ 21,375.00
Water supply and sanitary installations - 4% + 4% of the building cost = $14,25,000 \times (8/100) =$	₹ 1,14,000.00
Internal installations - 12% of the building cost = $14,25,000 \times (12/100) =$	₹ 1,71,000.00
Electric & gas services - 8% + 8% of building cost = $14,25,000 \times (16/100) =$	₹ 2,28,000.00
<b>TOTAL</b>	₹ 19,59,375.00
Contingencies – 3% overall - $19,59,375.00 \times (3/100) =$	₹ 58781.25
Supervision charges - 8% overall - $19,59,375.00 \times (8/100) =$	₹ 1,56,750.00
Design charges - 2% overall - $19,59,375.00 \times (2/100) =$	₹ 39,187.50
<b>GRAND TOTAL</b>	₹ 22,14,093.75

# EXAMPLE - 2

Prepare a preliminary estimate of a four storeyed office building having a carpet area of 2000 sq.m. for obtaining the administrative approval of the Government. It may be assumed that 30 % of the built up area will be taken by the corridors, verandas, lavatories, staircase, etc. and 10 % of built up area will be occupied by walls. The following data is given:

- Plinth Area Rate = ₹ 950.00 / Sqm
- Extra for special architectural treatment = 0.5% of the building cost.
- Extra due to deep foundation at site = 1% of the building cost.
- Extra for water supply and sanitary installations = 6% of the building cost.
- Extra for electric installations = 12.5% of the building cost
- Extra for other services = 5% of building cost
- Contingencies 2.5% overall
- Supervision charges = 8% overall

# DETAILED ESTIMATE

- It is prepared after its complete set of drawings are ready.
- It is an accurate estimate.
- It consists of working out the quantities of each item of works, and working the cost.
- It is prepared in two stages:
  - Details of measurement and calculation of quantities
  - Abstract of estimated cost

# DETAILS OF MEASUREMENT AND CALCULATION OF QUANTITIES

- Whole project is sub-divided into different items of work or activities.
- Quantities 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 "Details of Measurement Form" or "Bill of quantities".

# DETAILS OF MEASUREMENT FORM (or) BILL OF QUANTITIES

Sl. No.	Description of Item or Particulars	No.	Measurements			Quantity	Total Quantity	Remarks
			Length	Breadth	Height or Depth			

# ABSTRACT OF ESTIMATED COST

- Cost under item of work is calculated from the quantities already computed at workable rate.
- Total cost is worked out in the prescribed form – **Abstract of estimate form.**

Sl. No.	Description of Item or Particulars	Unit	Quantity	Rate	Amount	Remarks

# DETAILED ESTIMATE

- Rates are usually as per Schedule of Rates (SR) for the locality plus a premium to allow for rise in labour and material rates over and above the schedule of rates.
- 3% to 5% is provided on the total estimated cost for the work to allow for the possible contingencies due to unforeseen items or expenditure or other causes.
- 1.5% to 2% is also added to meet the expenditure of work-charged establishment.
- For beginners, it is convenient to make up the items in the order of construction from foundation to upward direction.

# DETAILED ESTIMATE

- Apart from drawings and details of measurements and calculation of quantities, the following documents are also usually submitted with the detailed estimate for obtaining Technical sanction:
  - A report explaining History, necessity, scope and main features of the project, its design, and estimate, etc.
  - Specifications laying down the nature and class of work and material to be used in various parts of the work.
  - The abstract of cost (priced Bill of Quantities) showing the total quantities under each sub-head, rate per unit of measurement, and cost.
  - Calculation sheets showing calculations for important parts of the structure.

# DETAILED ESTIMATE

## 1. Contractor's 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 purpose of financing the work and for checking bids and running bills submitted by contractors.

# DETAILED ESTIMATE

## 3. Progress estimate

- 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 monthly estimates.

# FACTORS TO BE CONSIDERED WHILE PREPARING DETAILED ESTIMATE

- **Quantity and transportation of materials**
  - For bigger project, the requirement of materials is more, such bulk volume of materials will be purchased and transported definitely at cheaper rate.
- **Location of site**
  - The site of work is selected, such that it should reduce damage or in transit during loading, unloading, stocking of materials.
- **Local labor charges**
  - The skill, suitability and wages of local labors are considered while preparing the detailed estimate.

# DATA RATE

- 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 labour 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.

# FIXING OF RATE PER UNIT OF AN ITEM

- **Quantity of materials & cost**

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

- **Cost of labour**

- The exact number of labourers required for unit of work and the multiplied by the wages/ day to get of labour for unit item work.

# FIXING OF RATE PER UNIT OF AN ITEM

- **Cost of equipment (Tools & Plant)**

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

- **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.

# METHODS OF TAKING OUT QUANTITIES

- The quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., can be workout by any of following methods:
  - Long wall - short wall method
  - Centre line method
  - Partly centre line and short wall method

# **LONG WALL - SHORT WALL METHOD**

**(or)**

## **SEPARATE OR INDIVIDUAL WALLS METHOD**

- The wall along the length of room (longitudinal direction) is considered to be long wall (Out-to-out).
- The wall perpendicular to long wall (transverse direction) is said to be short wall (in-to-in).
- Different quantities are calculated by multiplying the length by the breadth and the height of the wall.
- Same rule applies to the excavation in foundation, to concrete bed in foundation, D.P.C., masonry in foundation and super structure etc.

# LONG WALL - SHORT WALL METHOD (or) SEPARATE OR INDIVIDUAL WALLS METHOD

- Simple method is to take the long walls and short walls separately and to find out the centre to centre lengths of long walls and short walls from the plan.
- For symmetrical footing on either sides, the center line remains same for super structure, foundation and plinth.
- Long wall length (out-to-out) = Centre to centre length + half breadth on one side + half breadth on other side = centre to centre length + one breadth.
- Short wall length (in-to-in) = Centre to Centre length – one breadth.

# LONG WALL - SHORT WALL METHOD (or) SEPARATE OR INDIVIDUAL WALLS METHOD

- This method can also be worked out in a quicker way.
- **For long walls** – Find the length of the foundation trench of the long wall (out-to-out) in the same manner as explained.
- The length of the foundation concrete is the same.
- For the length of the first footing, subtract two offsets in foundation concrete from length of the trench or concrete.
- For the 2<sup>nd</sup> footing subtract from the length of the 1<sup>st</sup> footing two offsets.
- For 3<sup>rd</sup> footing subtract from the length of the 2<sup>nd</sup> footing two offsets.
- **For short walls** – Follow the same method but instead of subtracting add two offsets to get the corresponding lengths in-to-in.

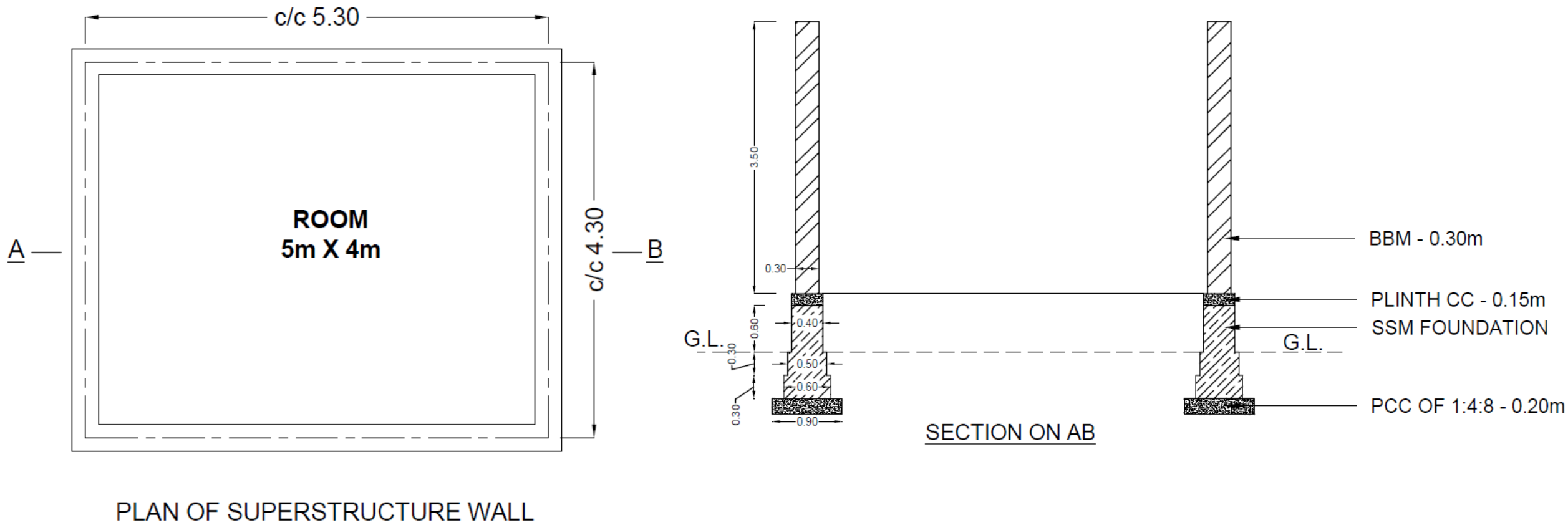


# PROBLEM

PROBLEM-1: Figure 1, the plan represents the plan of superstructure wall of a single room building of 5m x 4m, and section represents the cross-section of the wall with foundation. Estimate the quantities of –

1. Earthwork in excavation in foundation
2. Concrete in foundation
3. Size stone masonry in foundation
4. Plinth concrete and
5. Brickwork in superstructure

# LONG WALL - SHORT WALL METHOD (or) SEPARATE OR INDIVIDUAL WALLS METHOD



**Figure-1**

# LONG WALL - SHORT WALL METHOD (or) SEPARATE OR INDIVIDUAL WALLS METHOD

Sl. No.	Sl. No.	Description of Item or Particulars	Unit	Rate
1	2.1	Earthwork in surface excavation in foundation	Cum	249.00
2	4.3	PCC of Mix 1:4:8	Cum	5,102.00
3	5.6	SSM in foundation with cement mortar 1:6	Cum	4,596.00
4	4.5	DPC of Mix M20 with 20mm	Cum	5,328.00
5	6.13	BBM with CM 1:6	Cum	6,342.00

# CENTRE LINE METHOD

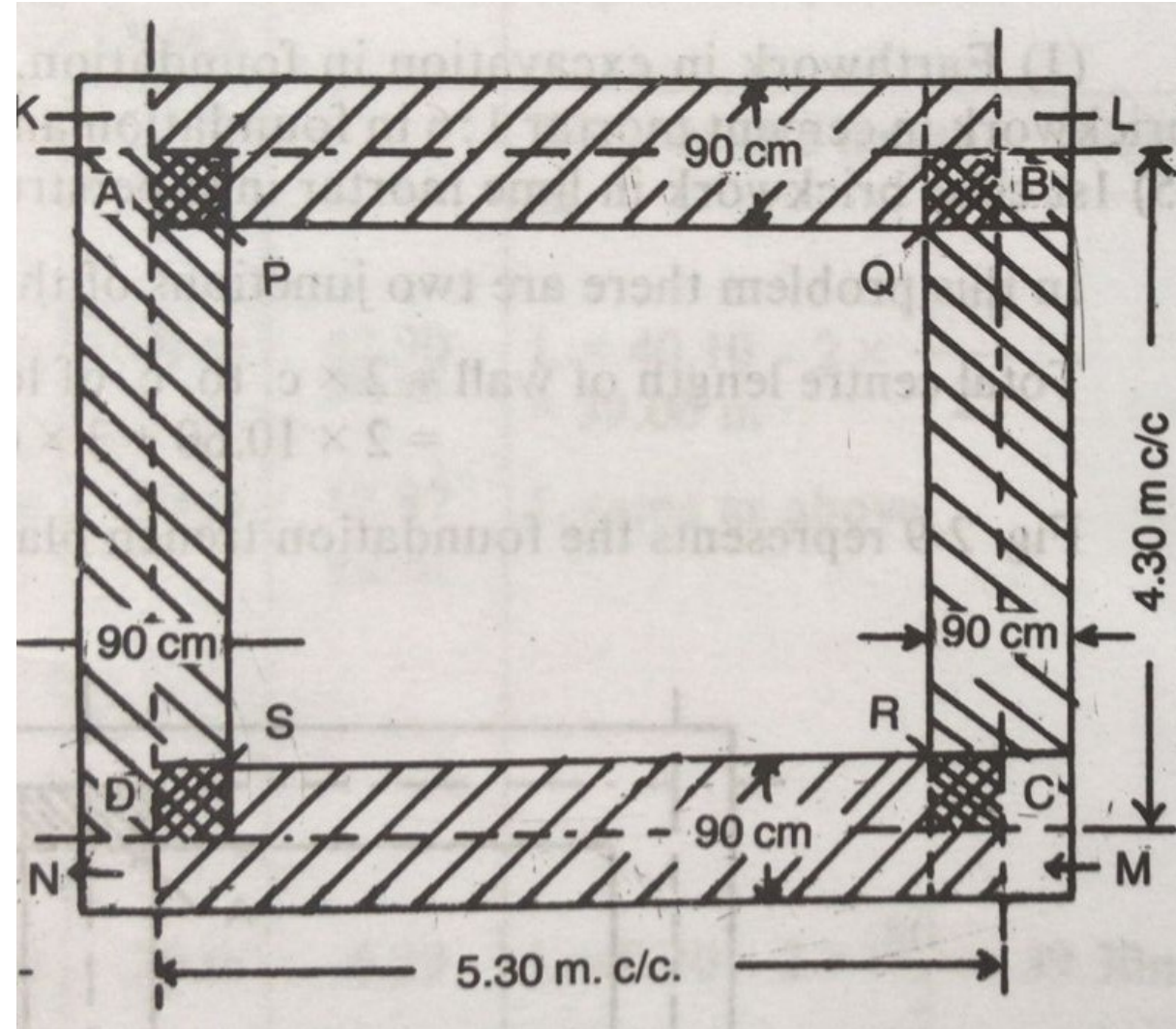
- In this method, total length of centre lines of walls, long and short, has to be found out.
- Find the total length of centre lines of walls of same type, having same type of foundations and footings and then find the quantities by multiplying the total centre length by the respective breadth and the 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 junctions).
- This method is quicker but requires special attention and considerations at the junctions, meeting points of partition or cross walls.

# CENTRE LINE METHOD

- 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 breadth of the respective item of work from the total centre length.

# CENTRE LINE METHOD

- Total centre length of walls =  $AB + BC + CD + DA = 5.30 + 4.30 + 5.30 + 4.30 = 19.20\text{m}$
- If the total centre length is multiplied by the breadth and depth we get the quantity of earthwork in excavation.
- Portions P, Q, R and S marked with double hatch lines come twice.
- Portions K, L, M and N left blank do not come at all, but these portions being equal in magnitude, we get the correct quantity.



# CENTRE LINE METHOD

- At the junction the portions A and B shown by hatch lines come twice, and we get the quantity in excess by these portions.
- These excesses have to be deducted.
- The deduction is effected by reducing the centre length by half breadth for each junction.

