

*GOVERNMENT POLYTECHNIC FOR GIRLS , AHMEDABAD*

*Civil Engineering Department*

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*Subject:- Estimating, Costing and Valuation*

*Subject Code:- 3350604*

*Semester:- 5th*

*Year:2020*



## ➤ **Unit– I**


# **Estimation and Modes of Measurement**

### ➤ **RATIONALE/INTRODUCTION:**


1. Definitions: Estimate , Estimating ,Quantity Survey, Costing
2. Data required for preparing estimate
3. Purpose or Objectives of estimate
4. Quality and duties of good engineer/estimator
5. Use or necessity of estimates:
6. Types of estimate
7. Method of Quantity estimation

## **RATIONALE:**

Building Estimation and Costing is a vital part of Civil Engineering. No project can begin without the total Building Estimation and Costing done by the Engineer. The entire Cost of construction and the infrastructure used for the purpose of construction is estimated and the final costing is done on the basis of which a certain percentage of the Project cost is paid to the Engineer, the Architect and other consultants involved in the project. Valuation is one such important part of Building Estimation and Costing. Valuation is done after the project is complete on the latest trends of the land prices in the market. Therefore, this course has been designed so that the diploma civil engineer is able to prepare estimate and cost of a civil engineering project.

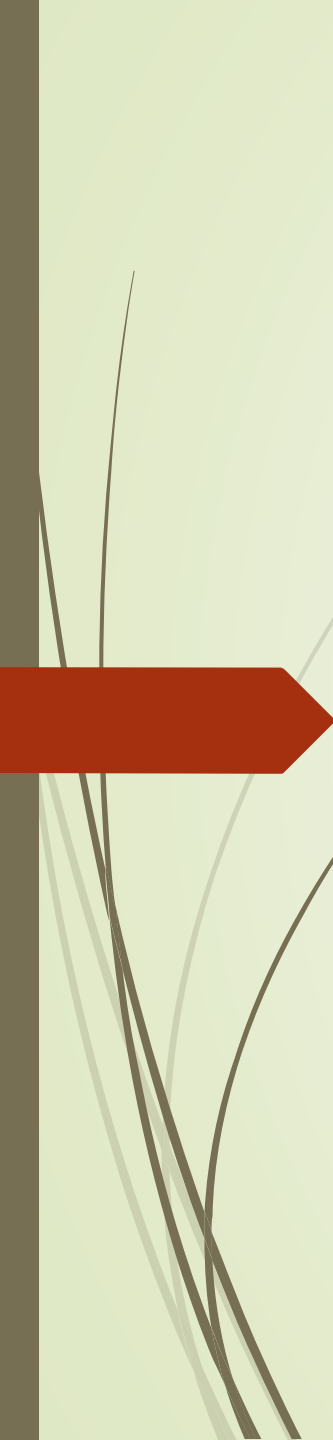


It is very important for technical pass out student of civil engineering that he/she should be able to prepare required drawings with details sections and brief specifications and able to interpret the given any civil engineering drawing. This is the basic requirement of the subject that you are going to study in ECV.



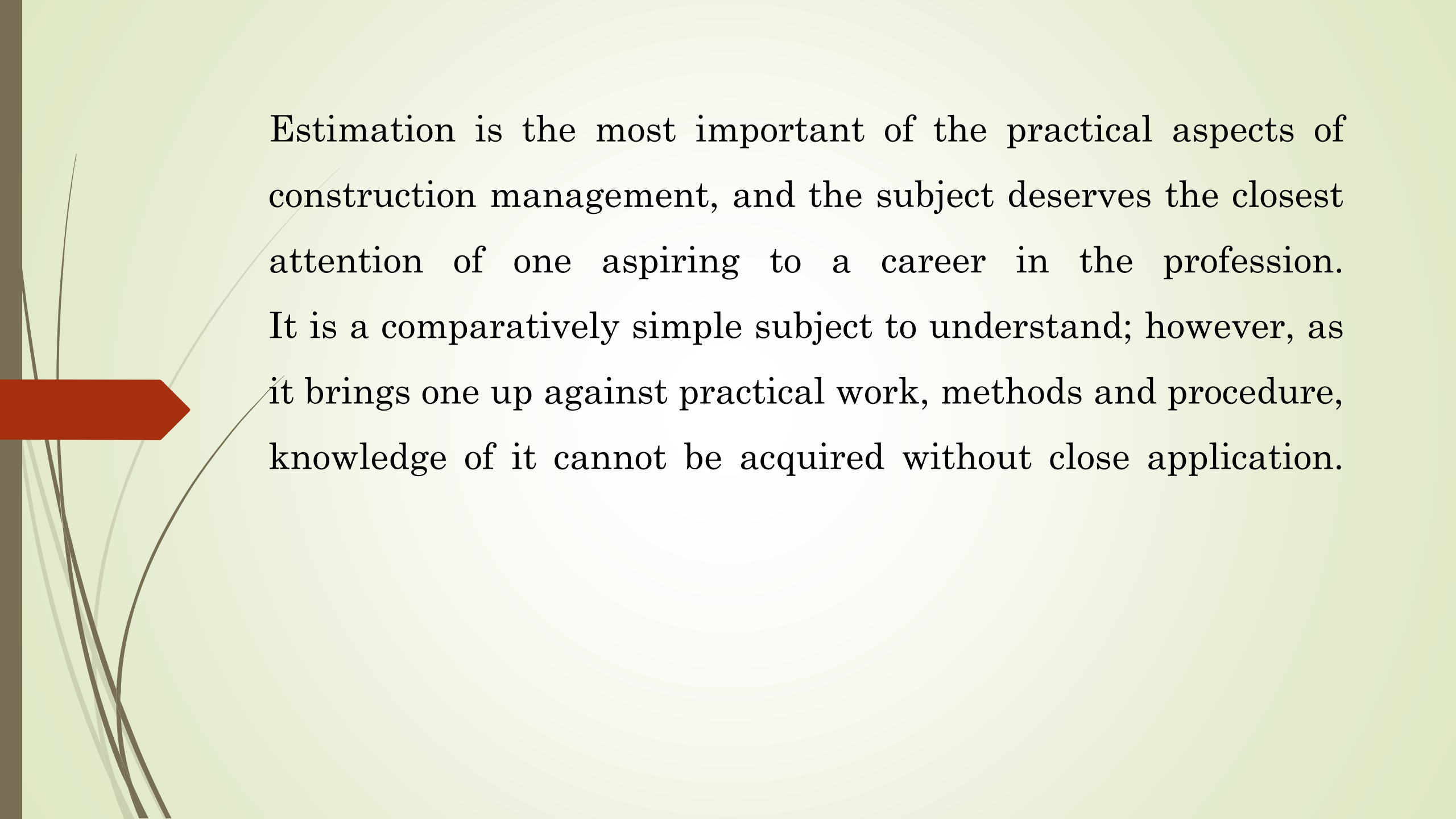
The civil engineering is a very vast field and have wide scope of works. The development of any nation depends on the infrastructure's facilities and construction activities. The different types of buildings are constructed by government and private agencies for the society.

There are various types of civil engineering structures and their construction depending upon the size of project. i.e. major and minor project.

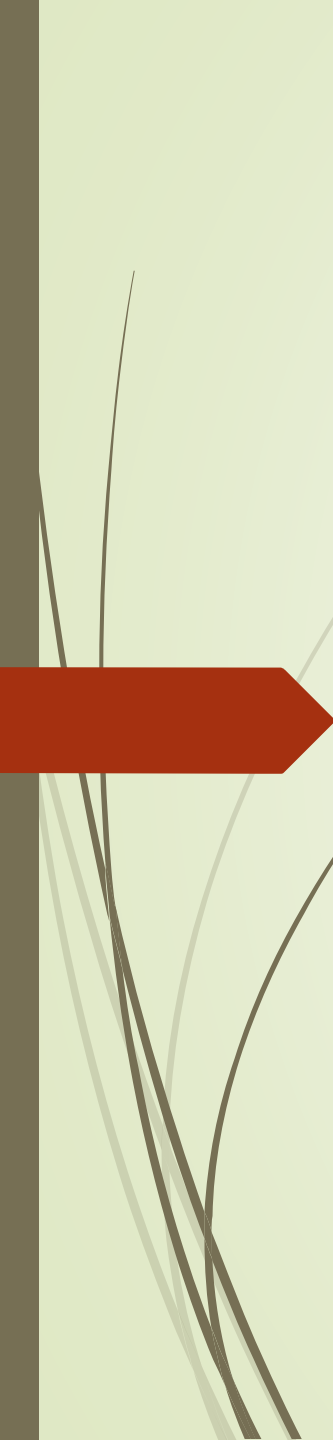
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- It may be....Residential building -small , low rise and high rise buildings
  - Commercial/public building- shopping complex, office and schools
  - Industrial building- sheds and godowns
  - Irrigation and allied structure- Dam, canal networks
  - Water supply and drainage works
  - Road and culverts, Bridges
  - Railway structure etc.

what is the main need to execute the construction of any type of building or structure?

Fund...Finance.....Amount....in terms of money is require to complete any type of construction or civil project work.



Estimation is the most important of the practical aspects of construction management, and the subject deserves the closest attention of one aspiring to a career in the profession. It is a comparatively simple subject to understand; however, as it brings one up against practical work, methods and procedure, knowledge of it cannot be acquired without close application.

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- So, to know the total or approximate amount or fund require for completion of any project or a small building, it is necessary to know the approximate cost of construction and For that we have to know the estimate and to carry out estimation to find the quantity of different materials required and their rate as per specifications.
  - Now we will learn various important points related an estimate





# 1. DEFINITIONS:

## ➤ 1.1 ESTIMATE:

An estimate is the anticipated or probable cost of work and is usually prepared before the construction is taken up. It is indeed calculations or computations of various items of an engineering work. An estimate is a calculation of the quantities of various items of work, and the expenses likely to be incurred thereon.

- ❑ It is defined as the process of determining the amount required for proposed work. And,
- ❑ It is prepared by calculating the quantities of different items of work with the help of measurements or dimensions from working drawing i.e. Plan, Elevation and Section of the work and by multiplying the unit rate of the items concerned.

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- Estimate is a document which furnishes **the quantities of different works involved, their rates and the expenditure** anticipate in a project.
  - The total of these probable expenses to be incurred on the work is known as estimated cost of the work. An estimate is necessary to give the owner a reasonably accurate idea of the cost to help him decide whether the works can be undertaken as proposed or needs to be curtailed or abandoned, depending upon the availability of funds and prospective direct and indirect benefits.
  - The estimated cost of a work is a close approximation of its actual cost.

## 1.2 ESTIMATION OR ESTIMATING:

- The process of determining the probable cost of a proposed structure is known as 'Estimating or Estimation'. And
- The documents prepared for the this details is called an ' Estimate'.
- 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.
- **IMPORTANCE OF ESTIMATE:**
  1. Financial provision
  2. Justification of investments
  3. Procuring materials

## 1.3 QUANTITY SURVEY


- The process calculating the quantities of items of works and materials involved in the project is called as or estimating
- It is the schedule of all items of work in a building. These quantities are calculated from the drawing of the building. Thus quantity survey gives quantities of work done in case of each items, when priced gives the total cost. In short, quantity survey means calculations of quantities of materials required to complete the work concerned

### ➤ **QUANTITY SURVEYOR or ENGINEER..... Able to do**

- Taking out Quantities
- Finding of missing Dimension And Calculating the Quantity
- Data (Calculation of Rate Per Unit) and use of SOR
- Measurement Sheet and Abstract Sheet ( Estimate )
- Billing of work



## 1.4 COSTING

- It is the total cost of proposed work obtained by multiplying the quantity of item with prevailing rate of construction of that item and sum of cost of all such item including the various charges .
  - Costing = Qty. of item x Rate of construction
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## 2. DATA REQUIRE FOR ESTIMATION

➤ The following requirements are necessary for preparing an estimate.

1. Detailed Drawings-Working drawing 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. (S.O.R.)

➤ **Detailed Drawings:**

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



## ➤ 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.

## ➤ CENTRE LINE PLAN

This is actually a layout plan drawn to facilitate the laying out of foundation lines and other features. It is generally fixed on the entrance or at exit in the central place of the colony for the guidance of the inhabitants and outsiders.



## ➤ SPECIFICATIONS

Detailed specifications 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.

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.



# RATES

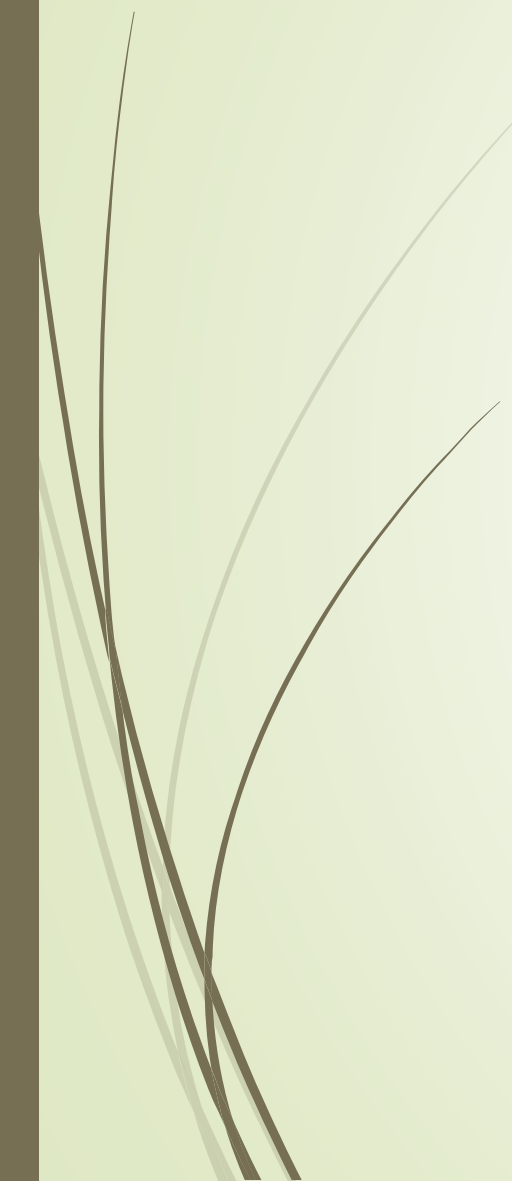
The rates of various items of works, materials to be used in the construction and the wages of different categories of labor (skilled and unskilled) should be available for preparing an estimate. The cost of transportation charges should also be known. As far as possible sanctioned “Schedule of Rates” shall be followed or the rates may be worked out by the “Analysis of Rates” method.


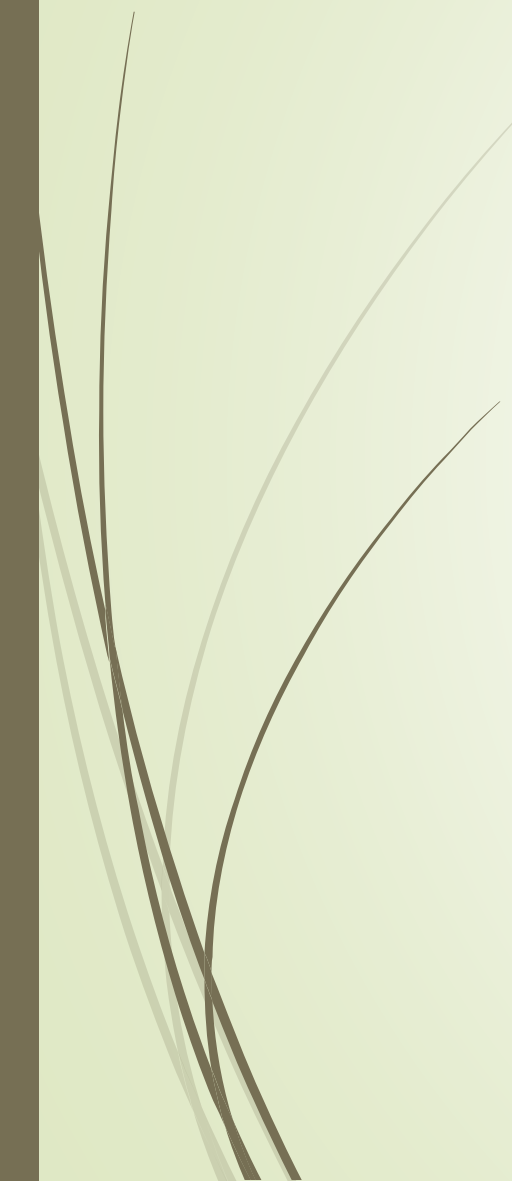
► For preparing the estimate the unit rates of each item of work are required.

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 labor, skilled or unskilled of masons, carpenters, Amador, etc.,



## ➤ **Schedule of Rate(S.O.R.)**

- The detailed document showing the unit rate of all construction materials, various construction items of works as per specification and prevailing market rate is prepared by government authority i.e. R &B (State govt.), Municipal corporation, and other competent authority. This document is known as SOR. The current required rate for any items can be considered for preparing detailed estimate.
  - The competent authority revised this SOR every year depending upon the market rate of materials , labor and other charges with the increment of some percentage of previous year rate.
  - The government agencies use the SOR for inviting tender of work and for material procurement.
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- Rate per unit of various items of work and materials ,rates of labor and rates of transport are given in the "Schedule of Rates " .
  - The S.O.R are prepared on the basis of analysis of rates .
  - Usually transport of materials in included in the rates .
  - If the workable rates differ much from the S.O.R then the rates are revised and anew S.O.R is prepared .

### **3. Purpose or Objectives of Estimate:**

1. To know the probable cost of the work and hence its feasibility can be determined. i.e. whether the project could be taken up with the funds available or not.
2. To know about the requirements of material and its quantity
3. To know about the plant and equipment required for construction.
4. To know nos. and types of worker and labors required.
5. To obtain administration approval and technical sanction.
6. To estimate the time limit for the completion of the work.
7. To plan construction schedule and stage wise requirements of funds as per schedule.
8. To invite tender and quotations to arrange the contract for propose work.
9. To control the expenditure during the execution of work

## 4. QUALITY Or DUTIES OF GOOD ENGINEER : (Requirement of good engineer)

- Good knowledge of reading and interpreting all types of civil engineering drawing correctly and able to prepare the bill of quantities accurately.
- Good knowledge of the construction details and its procedure.
- He should be able to write the description and specification of different items of works.
- Knowledge of local available materials, types ,their rate and use of S.O.R .
- Knowledge of wages of different types of labor and tools and equipment required in construction.
- Knowledge of measurement unit of different item of work ant its conversion.
- Knowledge of mode of measurement as per IS:1200 PART I to XXV
- Knowledge of trigonometry and simple calculation.

## 5. USE or NECESSITY OF ESTIMATES:

- To know about the approximate cost of the building construction and planning of fund for stage of construction.
- To calculate the tax of the building
- To fix the rent of building
- To know about the various items of works involved in the building construction and arrange the available materials of the construction.
- To arrange the labors, tools and plants of the construction works.
- To take the approval for the government projects.
- To get the loan from the bank.

## 6. TYPES OF ESTIMATE:

There are main two types of estimate:

1. Approximate estimate and
2. Detailed estimate:

➤ The estimates may also be divided in to the following categories:-

- **(1) Preliminary or Approximate estimate.**
- **(2) Detailed estimate.**
- (3) Annual repair estimate.
- (4) Special repair estimate.
- (5) Revised estimate
- (6) Supplementary estimate.

# 1. Approximate estimate:

- It is also known as Preliminary or rough estimate. This is made to find out an approximate cost in short time and is required for studies of various aspects of work of project finance.
- During preparation of this, detailed drawing, design, surveying etc. are not required but preliminary investigation, preliminary surveying, sub soil tests are conducted to know soil bearing capacity. The approximate estimate of main parts of project as for buildings, services like sanitary, water supply, drainage, electrification, boundary wall, roads, if any, cost of land etc. are made separately and is prepared from the practical knowledge and cost of similar works. The estimate is accompanied by a report duly explaining necessity and utility of the project and with a site or layout plan. Provision of contingency @ 5 to 10% is added with the abstract which is the total approximate cost of the project.



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 metaling.

Irrigation Channels

- Per km basis
- Per hectare basis (Area of land commanded)

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- 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.

### **PURPOSES OF APPROXIMATE ESIMATE:**

1. Preliminary studies
2. Investment
3. Financial aspects
4. Tax Schedules
5. Insurance
6. To obtain administrative approval

## **METHODS OF APPROXIMATE ESTIMATE:**

Approximate estimate can be quickly prepared by different methods and using some formula for material calculation.

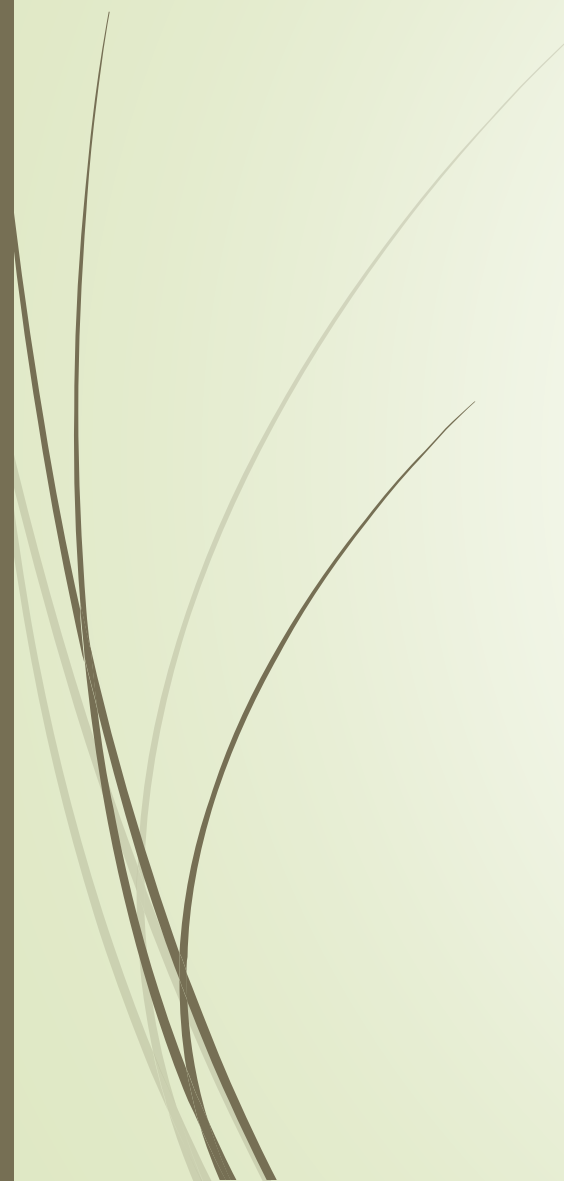

The following are the methods used for preparation of approximate estimates.

1. Service Unit method
2. Plinth area method
3. Carpet area method
4. Cubical content method
5. Typical bay method
6. Approximate quantities method
7. Empirical equation method

## 1. Service Unit Method:

- ▶ The service unit indicate most important unit in a structure.
- ▶ Approximate cost of a proposed structure = [ Nos. of service unit in a proposed structure x cost of corresponding service unit in a similar existing structure]

<b>Sr.No.</b>	<b>Name of Structure</b>	<b>Service Unit</b>
1	School Building	Class room
2	Hospital	Bed
3	Water Tank	Liter
4	Large Apartment	Tenement
5	Cinema/ Theater	Seat
6	Prison	Cell
7	Stable	Animal



8	Hotel	Room
9	Office building	Room
10	Stadium	Seat
11	Dam	Hectare m.
12	Canal	Kilometer
13	Road	Kilometer
14	Bridge	Nos. of span

## 2. Plinth Area method(IS:3861)

- Plinth area shall be means the built up covered area measured at the floor level of any storey. Plinth area is calculated by taking the external dimension of the building at floor level excluding plinth offsets if any.
- Estimated cost of proposed building =[ Total plinth area of proposed building x Cost per Sq.m. of similar existing building]
- The following factors affect the rate calculation .  
Locality, Types and Year of Construction, Height, Materials, quality of work

### 3. Carpet Area method

- Carpet area mean the covered area of the usable rooms at any floor level.
- Carpet area = [ Total floor area ] – [ Circulation area, verandah, passage, staircase, corridor, lift etc. ] – [ Sanitary accommodation, bath, w.c. ]
- Approximate cost = Total Carpet area of proposed building x Cost per Sq.m. of Carpet area of similar existing structure
- Carpet area for Residential building = 50 to 60% of Plinth area and  
For Office building = 60 to 75% of Plinth area

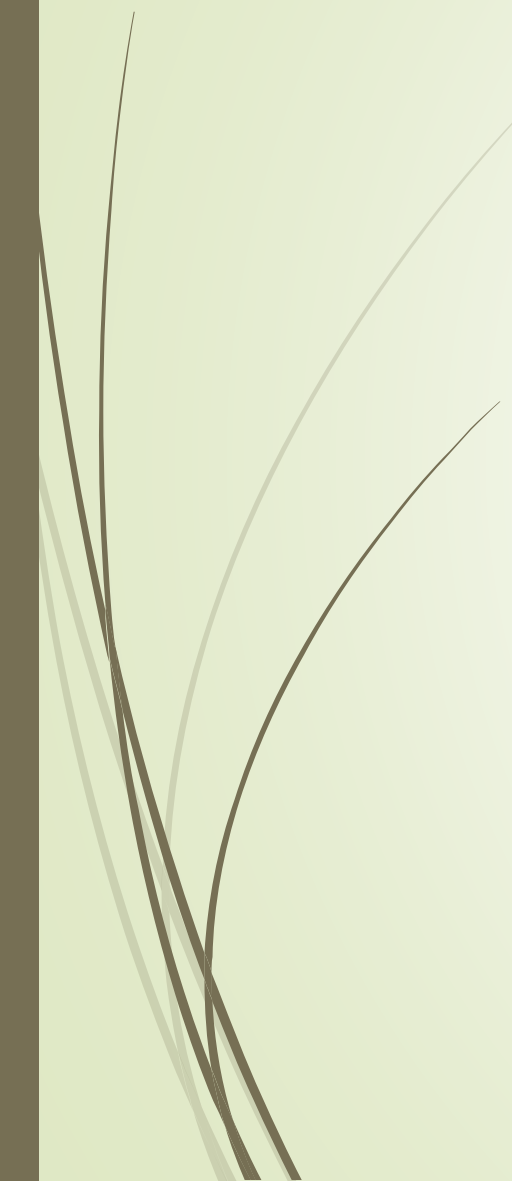
## 4. Cubical content method

- Cost per cubic meter is used to find put the approximate cost of the proposed building.
- Approximate cost proposed building = [Total cubical content of proposed building] x [Cost per cubical content of a similar existing building]
- Measurement of area are taken as a case of plinth area method and this area is multiplied by the height of floor so as to get cubical contents of the proposed building.
- It is necessary to employ the same person to take the measurement and to fix the cost per cubic meter for accurate result.
- For storied building the height should be taken between the floor level of one storey to top of next higher floor .





## Conti...

- The foundation ,plinth ,parapet above roof are not taken in to account in finding the cubical content .
  - Cube rate estimate is most accurate as compared to the plinth area estimate as the height is also compared .
  - Note : the cube is made up by taking plan diminutions from the outside faces of brick walls .and vertical dimension from the top of foundation to half way up a pitched roof or 0.61m above a flat roof .
  - This method is unreliable since tow building having identical areas of accommodation but differently designed and constructed could have very different volumes
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## 5. Typical BAY Method

- This method is useful in case of building which have several similar bays.
- A bay is a space from center to center of two successive column.
- Atypical interior bay is selected and its cost is worked out.
- Approximate cost proposed building = [Nos. of bays in proposed building] x [Cost of one bay of similar existing structure]
- Necessary creation should be made for the end bays due to end walls and also in other bays if there is any difference in framing.
- This method is useful for factory and such similar structure.
- More time required but the result obtained are found to be more reliable.

## 6. Approximate Quantity method

- The various quantities are worked out with the help of many short cut.
- i.e. Wall foundation are measured in linear measurement ( running meter), approximate quantities of excavation, foundation concrete, brick work, up to plinth level, DPC are computed per running meter and rates of these items per running meter are multiplied to get approximate cost of building up to plinth level.
- Similarly ,the super structure is measured in running measurements and a suitable rate per rmt. Is used for item of work to determine approximate estimate.
- The grouping items and fixing of their approximate price depends on experience of the estimator.
- This method gives an estimate which is very near to final estimate out of all previous method .

## 7. Empirical Equation method

- ▶ The quantities of materials and labor required for a building can be worked out with the help of certain empirical equation developed by the Central Building Research institute(C.B.R.I.) ,India.
- ▶ The equation are for single storey structures and excluding services.
- ▶ Following are the equations in which (A) represent the Plinth area of building in sq.m.

1. Bricks in Nos.=  $226A + 6680$

2. Brickbats in cu.m.=  $0.113A - 0.83$

3. Cement in tones =  $0.153A + 0.57$

4. Steel in quintal =  $0.213A - 3.14$

5. Sand in cu.m. =  $0.47A - 7$

6. Aggregate in cu.m. =  $0.176A + 1.5$

7. Mason in nos.  $1.335A + 28$


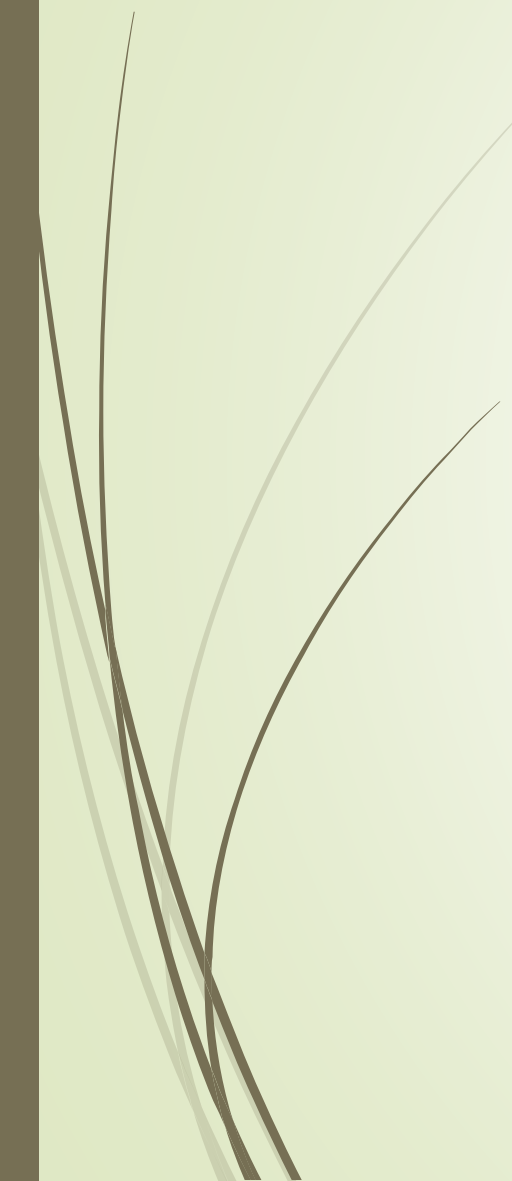
## **2. DETAILED ESTIMATE:**

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

### **1. Details of measurements and calculation of quantities**

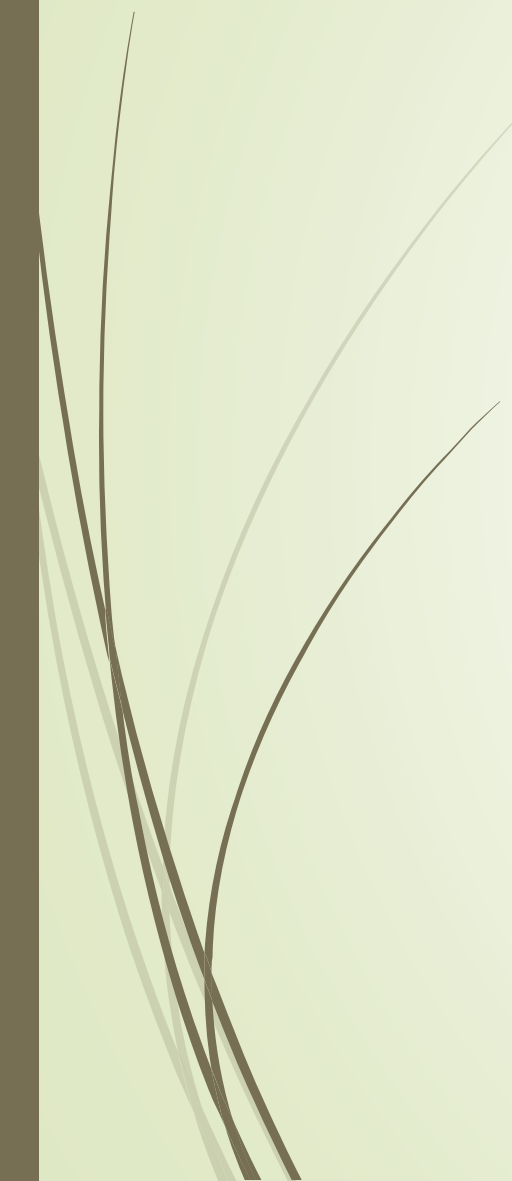
### **2. Costing**

- 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 preformed. The quantities are calculated by multiplying the values that are in numbers column to Depth column in measurement sheet as shown below:

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- After getting Administrative approval on rough cost estimate, detailed estimates are prepared.
  - In this, the estimate is divided into sub-heads and quantities of various items are calculated individually.
  - In the end of the detailed quantities, an *abstract of cost* giving quantities of each item and rate of every item according to the sanctioned schedule of rates shall be attached. In case of non-schedule rates i.e. rates which are not given in the sanctioned schedule of rates, proper analysis of rates shall be attached. If however the work proposed to be constructed is located in a remote place, the provision for the carriage of the material shall be added in the estimate to avoid any excess over the administratively approved estimate later on. Detailed specifications & report should also be attached with the estimate. Technical sanction is given on detailed estimate.
  - The detailed estimate shall also provide for the cost of approach road, water supply, electric installations and acquisition of land etc, so as to call it a comprehensive estimate.



### 3. Annual repair estimate

- In order to keep building and roads in perfect and safe condition, annual repairs should be carried out as follow:-
  - (i) In case of a building-white washing, oiling and painting of doors and windows, cement plaster repairs (inside & outside), repairs of floors, minor repairs etc. In no case this annual repair amount should increase more that 1.5% to 2% of the capital cost of the building.
  - (ii) In case of a road-Annual Repair estimate provides for patch repairing, maintenance of berms, repairs of bridges and culverts etc.
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## 4. Special repair estimate

- If the work cannot be carried out of the annual repair funds due to certain reasons resulting in the genuine increase in cost, then special repairs estimate is to be prepared.
- The reason of increase may be:-
  - (i) In case of a building-opening of new doors, change of floors, re plastering on walls etc.
  - (ii) In case of roads-if the whole surface is full of corrugation & patches, then the total surface is to be scarified. The old metal is taken out, consolidation by adding more metal is done and top surface is repainted.



## 5. Supplementary Estimate

- When some additions are done in the original work, a fresh detailed estimate is prepared to supplement the original work. This estimate is called supplementary estimate. It is also accompanied by all the papers as required in thru detailed estimate.
- This is fresh detailed estimate in addition to the original sanctioned estimate prepared when additional works are deemed necessary during the progress of a work to supplement the original works. The abstract of cost should show the amount of the original sanctioned estimate as well as the supplementary amount for which sanction is required.

## 6. Revised Estimate :

- When the **sanctioned estimate** exceeds by 5% either due to the rate being found insufficient or due to some other reasons, a fresh estimate is prepared which is called a Revised Estimate.
- 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.
- A comparative statement on the last page of the estimate is attached giving there in the reasons of the increase of cost in case of each item.

## 7. Supplementary and Revised Estimate

- When a work is partially abandoned and estimated cost of remaining work is less than 95% of original sanctioned estimate.
- When there are material deviations and changes in the design
- If at any time before or during the execution of work, it is found that original estimate is excessive then divisional officer may sanction a revised estimate of reduced amount.




## 8. Complete Estimate

The estimate which includes, in addition to the cost of construction, the cost of land, the expenses towards surveying, preparation of plans and estimates, legal assistance, registration of documents, payment of taxes and service charges , etc.... Is called complete estimate.

## 9. Sub Estimate

Sub estimate are being prepared for each and every such items in detail to ensure and see that the expense towards these items do not exceed the corresponding provisions already made in the original estimate.



# Electrifications ,Sanitary and water supply works

- A percentage of about 8 to 10 % of the estimated cost of building is provided for each.
- **Internal electrification includes :**
- Electric wiring for light ,fan ,plug points , brackets , shades, holders , switch boards ,cut out
- **Internal Water supply works include:**  
Water pipe ,bib cocks ,stop cocks ,fittings , overhead tanks ,and sewer sanitary Internal pipe water closets ,fittings traps.

## Sub Head works:

- The total cost of a work is divided for financial control ,the work is divided in to different classes ,and item :
- (i)Earth work .
- (ii) Concrete .
- (iii) Brick work .
- (iv) Stone work .
- (v) Wood work .
- (vi) Steel work .
- (vii) Roofing .
- (viii) Flooring .
- (ix) Plastering .
- (x) Painting .
- (xi) Miscellaneous items.

## 2. DETAIL 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. AND It 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.

# PROCEDURE 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
- 
- Steps of details Estimate:
    1. Taking out quantities of items of works
    2. Costing of each items and calculating total cost
    3. Adding other charges @ % of total cost



## Details of measurements Sheet:

Sr. No.	Description	No.	Length L (m)	Breadth B (m)	Depth/ Th. (m)	Qty.	Total Qty.
1	Excavation in foundation						
2	BBCC or PCC in foundation for footing						
3	1 <sup>st</sup> class brick masonry in foundation (a) Up to G.L. (b) Above G.L.to P.L.						
4							

## ➔ ABSTARCT SHEET:

The cost of each item of work is worked out from the quantities that already computed in the details measurement form at workable rate. But the total cost is worked out in the prescribed form is known as abstract of estimated form.

Sr. No.	Description	QTY.	Rate		Unit	Amount	
			Rs.	Ps.		Rs.	Ps.
1	Excavation for foundation						
2	BBCC or PCC in foundation for footing						
3	1 <sup>st</sup> class brick masonry in foundation (a) Up to G.L. (b) Above G.L.to P.L.						



THANK YOU