L.U 1 EXAMINE THE WORKS

1.1 DETERMINE THE WORK EXTENT

During the process of determining the work to be carried out in any construction project you must first access some of the following key points:

- ✓ Working place
- ✓ Duration
- ✓ Outdoor location(External factor)
- ✓ Indoor location(internal factor)
- ✓ Complexity
- ✓ Maintenance cost

In cost estimation the respect of dimension as required by the clients is also an important issues that the estimator must follow as it is required in tender:

These dimensions to be followed are the following:

- ✓ Length
- ✓ Width
- ✓ Height
- ✓ Thickness
- ✓ Accuracy
- ✓ Clearness
- ✓ Completeness

1.2 ANALYSE THE COMPLEXITY OF THE WORK

The estimator to ensure the success of the project he/she must understand clearly the complexity that may influence the performance of the project.

Some of these complexity are the following:

- ❖ Quantity of materials
  - ✓ Shape (size…)
  - ✓ Specification
- ❖ Quality of material used
  - ✓ Type of materials used
- ❖ Human resources materials
  - ✓ Labor availability
  - ✓ Availability of funds

1.3 LOCALIZE WORK DURATION

Working location

- ✓ Indoor location
- ✓ Outdoor location
- ✓ Out-country location

1.4 DETERMINE WORK DURATION

Steps of work duration determination

- ✓ Time of each task
- ✓ Determination of concurrent tasks
- ✓ Total time

Estimate the work duration

To estimate the work duration needed to complete a given activity you must have successful information on :

- ✓ Productivity hour per day
- ✓ How many resources on each activity
- ✓ Available work days
- ✓ Delays-lag time(effort hours)
- ✓ Resources constraints(activity done sequentially or parallel)
- ✓ Maintenance days

Methods for the Estimation of Activity Duration in Project Management

When you create project plans, you need to assess the time required to complete individual activities. Use duration estimates to get an idea of this time and determine the schedule you need to adhere to in order to complete projects. You can use various methods to estimate activity duration, depending on the nature of the activities.

PERT Method

The Program Evaluation and Review Technique, or PERT, estimation method is a weighted average of three scenarios. First, compute the averages for optimistic, pessimistic and most likely time scenarios. PERT gives more weight to the most likely scenario, so multiply that average by four. Combine this result with the optimistic and pessimistic averages, and divide the result by six to come up with a final estimate. The optimistic scenario presumes all goes well, and you can complete the activity without issues. Conversely, with the pessimistic scenario, you imagine everything will go wrong and it'll take longer to complete the activity. The most likely scenario assumes you can complete the activity without surprises. The PERT estimation method is a good

3-point estimate or PERT

- Uses 3 estimates (optimistic (O), most likely (M), pessimistic (P))
- Triangular distribution = (O + M + P) / 3 – used infrequently
- Beta Distribution = (O + 4M + P) / 6 – use most often

How to estimate activity duration?

- Involve the team, project managers and work package owners.
- Examine historical information and previous practice
- Decide how you want to quantify the work
- Don‟t forget resource requirements and capabilities
- Determine which estimation method to use
- Modify constraints and assumptions from other planning processes
- Verify accuracy of estimates
- Consider the need for time reserves

PERT Three Point Estimating

PERT technique (Project Evaluation & Review Technique)

Uses three estimates, to define an approximate range for an activity‟s duration

Σ = Expected Time or Expected Duration

O = Optimistic P = Pessimistic M = Most Likely

Sigma σ

The standard deviation of an activity

- Degree of variation from the average - (mean)
- Indicates the standard error in the estimate and provides an idea of its accuracy
- the larger the standard deviation (spread between the optimistic and pessimistic estimates), the larger the risk in the estimate

± 1 standard deviation = 68.26%
± 2 standard deviations = 95.46%
± 3 standard deviations = 99.73%
± 6 standard deviations = 99.999998% - also known as Six Sigma

Statistical Concepts

Normal distribution curve

- Standard Deviation = σ
- How close the data points (measurements) are to the mean (m) when plotted on a graph

Variance and Standard Deviation

Variance of the activity = square of the standard deviation = Sigma squared

Variance and the standard deviation measure variability, and are measures of how spread out a distribution is (from the mean)

Another term – heuristics (simple rule of thumb) – six sigma is an example

Question:

Your project has a critical path equal to 30 days and a standard deviation of 2½ days.

What will be the earliest finish and latest finish estimates for this project within a 95% confidence level?

Answer

The question gives you:

- a standard deviation of 2½ ,
- your confidence level is 95% which is two standard deviations,
- therefore you multiply the 2½ by 2 to get 5.

You add the resulting 5 to the project duration to give you the upper end of the variance range = 35

You subtract that 5 from the project duration to give you the lower end of the variance range = 25

Your answer:

- will be the option which states Earliest finish estimate of 25 and latest finish estimate of 35.

Exercise - Calculate…

The PERT Duration of the Critical Path Activities, Standard Deviation (σ), Variance (σ^2), Project‟s PERT Duration, and Standard Deviation (σ Project =√ Σ variances))

If all the activities above are on the Critical Path, what is the project's mean duration and σ ?

Answer:

Project's mean duration = 170.99 days and σ=10.1 days

Analogous Estimation

The analogous, or top-down, estimation relies on information from similar projects to determine the activity duration for a current project. You'll need historical data and a degree of expertise about the similar projects, because the reliability of your estimation depends on how closely the activities match the projects you're using as comparisons. Use this method at the beginning of a project when you don't have all the details. Adjust the estimates as you learn more about the tasks and how long they can be expected to take with the resources available.

Parametric Estimation

The parametric estimation is similar, but more accurate, than the analogous estimation. To use it, multiply the number of units you need by the time it takes to produce the units. You'll need historical information about similar activities to complete your estimate. The method is scalable. This means if your historical data tells you that it takes one person an hour to produce one unit, you can reasonably estimate that you can complete three units within one hour if you allocate three workers to the task. When you use this method, it's important to account for all tasks that impact the activity. For example, if the workers spend part of the time preparing materials, account for that time in your estimates.

Expert Judgment

If your project is complicated and a number of factors can influence the duration of your activities, you might want to use expert judgment to estimate activity duration. Experts knowledgeable in a particular area can judge the time and resources you'll need to complete activities in that area. Be careful when choosing experts or using their estimates, because they may have certain biases that might influence their estimates. You also can gather estimates from external experts. If you can get external estimates at reasonable cost, it might be prudent to rely on them instead of generating estimates internally.

The Delphi Technique

The Delphi technique makes use of group intelligence to determine activity duration. The technique involves gathering opinions from several experts and then sending the responses back to the experts for their review. They can change their opinions after reviewing the responses. The process might involve several rounds, as you want to investigate differences of opinion and get to a consensus. To reduce bias and prevent individual experts from overly influencing

results, experts submit their opinion anonymously. You can use a third party to gather the opinions.

Work Breakdown Structure

Certain activities might be too large or complex for a reliable duration estimate. If an activity takes up more than 10 percent of the project schedule, you might want to break it into several different tasks. You can use a work breakdown structure to reduce these activities into smaller, more manageable tasks. Doing this enables you to set priorities and estimate the duration of tasks more accurately. A work breakdown structure also is useful for building accountability, because you can assign specific tasks to designated project participants.

N.B in daily life the useful methods is Parametric

Activity Duration=(Quantity of work)/(Number of Crews*Resource Output)

Activities Cost= Activity Duration * Cost of the Crew per Unit Time

Example:

1.

. If the daily production rate for a crew that works in an activity is 175 units/day and the total crew cost per day is 1800 F. The material needed for daily work is 4.5 units at 100F/unit.

a. Calculate the time and cost it takes the crew to finish 1400 units
b. Calculate the total unit cost. Consider an eight hour work day.

ANS1.

a. Duration (units of time) = Quantity / Production per unit of time x number of crews

= 1400 / 175 x 1 = 8 days

Cost (labor cost) = Duration (units of time) x crew cost per unit of time

= 8 days x 1800 F / day = 14400 F

Total direct cost = 14400 F + 4.5 units of material x 100 F / day x 8 days
= 18000 F/**2marks**

b. Unit cost=total cost/quantity
= 18000 F / 1400 = 12.86 F/ unit

2. What is the duration in days to install 6000 square feet of walls shuttering if: / **8 Marks**

a. Crew of 2 carpenters is used with output of 200 square feet/day
b. Productivity is measured as 0.008 man-hour/square feet. Number of carpenters=3, and number of working hours/day = 8 hours

ANS2.

a. Duration = 6000 / 200 = 3 days
b. Total man-hours needed = 6000 x 0.008 = 48 man-hours (if one man used) Duration = 48 / 8 = 6 days (if one man used)

Duration using 3 men = 6 / 3 = 2 days

L.U.2.DETERMINE REQUIRED RESOURCES

L.O.2.1 QUANTIFY MATERIALLS

Introduction

Quantity survey means estimating of quantities of different items of work.

A quantity surveyor is a professional working within the construction industry concerned with building cost. The main role of quantity surveyor is to estimate the cost of civil engineering work. Each building can be divided into different parts, costs of each part can be estimated and adding cost of all parts of building together will give contractors an estimated cost for the whole work.

Every good quantity surveyor must have a good knowledge of building materials and construction (should provide correct calculation) and be able to visualize drawings and details.

A quantity surveyor is a descriptive title in which despites the role provided by a profession in producing a bill of quantity.

A bill of quantity is a document which quantifies in details the scope of construction project using a standard method of measurement and is typically used in the tender process for pricing and analysis purpose.

Quantity surveying is important in:

- Determination of quantities of items of civil engineering works
- Preparation of estimate of civil engineering works
- Preparation of tender documents for civil engineering works
- Determination of labor requirement for civil engineering items

Definition of estimate and its different types

An estimate is an approximate calculation of the cost of works to be done. For all engineering work, it is required to know beforehand the probable cost of construction work known as "**Estimated cost**" .If the estimated cost is greater than the money available, then attempts are made to reduce the cost by reducing the work or by changing the specifications.

In preparing an estimate, the quantities of different items of work are calculated by simple measurement methods and from these quantities the cost is calculated.

Estimating is the technique of calculating or computing the various quantities and the expected expenditure to be incurred on a particular work or project. The following requirements 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.

i. Need for 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.
- 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.

Estimating involves the following operations

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

ii. **Data required in preparation of an estimate**

- **Drawings** (plans, elevations, sections etc): If the drawings are not clear and without complete dimensions the preparation of estimation become very difficult. So, it is very essential before preparing an estimate.
- **Specifications**:

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

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

- **Rates:** For preparing the estimate the unit rates of each item of work are required:

1. for arriving at the unit rates of each item.

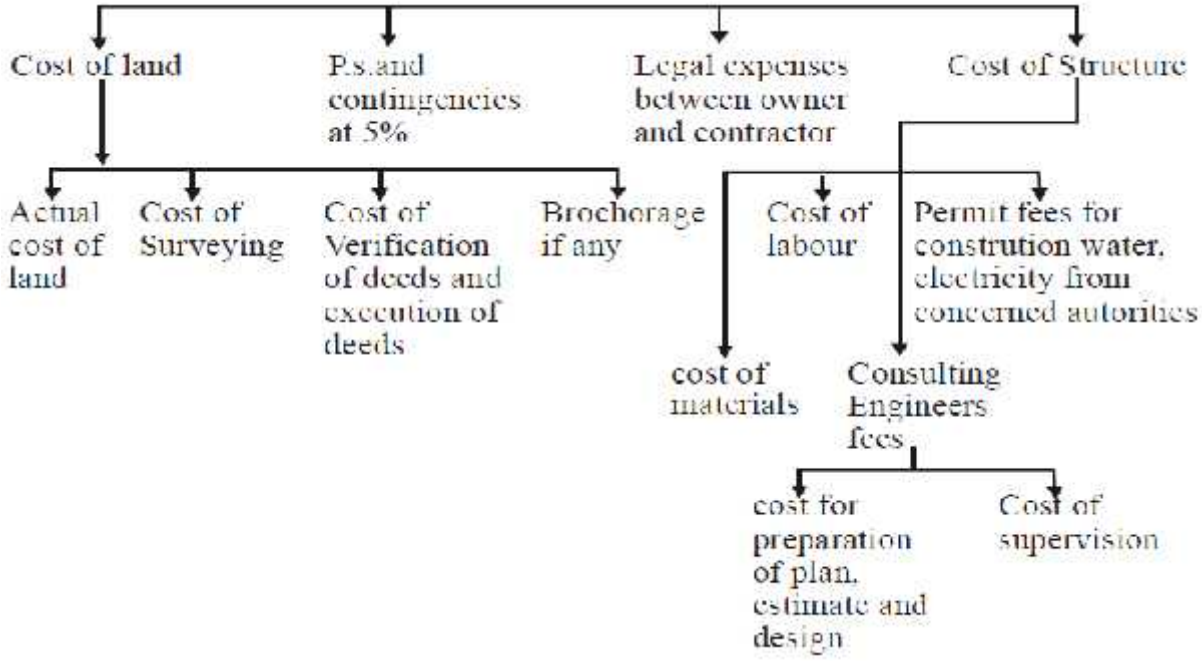
2. The rates of various materials to be used in the construction.

3. The cost of transport materials.

4. The wages of labor, skilled or unskilled of masons, carpenters, etc.

iii. **Complete estimate**

Most of people think that the estimate of a structure includes cost of land; cost of materials and labor, but many other direct and indirect costs included and are shown below



The complete estimate of a project or building structure should include all items of expenditure from the beginning up to the end.

iv. **LUMPSUM:**

While preparing an estimate, it is not possible to work out in detail in case of petty items. Items other than civil engineering such items are called lump sum items or simply L.S. Items.
The following are some of L.S. Items in the estimate.

- 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 prepared or at the end of execution of work, the actual cost should not exceed the L.S. amounts provided in the main estimate.

Contingencies indicates incidental expenses of miscellaneous character which cannot be classified under any distinct item sub-head, yet pertain to work as whole. Provision for contingencies 3% to 5% of estimated cost, is made in the estimate to cover the miscellaneous petty expenditures which do not come under any item of work.

v. 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 charged establishment.

Types of estimate

Before undertaking the construction of a project it is necessary to know the probable cost which is work out by estimating. The primary object of the estimate is to enable one to know beforehand, the cost of the work. The estimate is the probable cost of a work and is determined theoretically by mathematical calculations based on the plans and drawings and current rates.
Approximate estimate may be calculated by various methods but accurate estimate is prepared by detailed estimate method. Normally, there are two types of estimate: Detailed estimate and Approximate estimate.

Approximate 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. The estimate is accompanied by a report explaining necessity and utility of the project and with a site or layout plan. A percentage 5 to 10% is allowed for contingencies. The following are the methods used for preparation of approximate estimates.
a) Plinth area method

b) Cubical contents methods

a. Plinth area method

Plinth area is the built up covered area of a building measured at floor level of any storey. The plinth area is calculated by taking the external dimensions of a building at the floor level excluding plinth offsets if any. Court-yard, open areas, balconies and cantilever projections are not included in the plinth area. Supported porches (other than cantilever) are

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

a) Area of walls at floor level.

b) Internal shafts of sanitary installations not exceeding 2.0m2, lifts, air-conditioning ducts etc.,
c) Area of barsati at terrace level: Barsati means any covered space open on one side constructed on one side constructed on terraced roof which is used as shelter during rainy season.
d) Porches of non-cantilever type.
Areas which are not to include:
a) Area of lofts.

b) Unenclosed balconies.

c) Architectural bands, cornices etc.,

d) Domes, towers projecting above terrace level.
e) Box louvers and vertical sun breakers.
Examples:
Example 1: Prepare an approximate estimate of building project with total plinth area of all building is 800 sqm, and from following data:
i) Plinth area rate Rwf. 4500 per sqm

ii) Cost of water supply @7½%of cost of building.

iii) Cost of Sanitary and Electrical installations each @ 7½% of cost of building.
iv) Cost of architectural features @1% of building cost.
v) Cost of roads and lawns @5% of building cost.

vi) Cost of Petty Supervision (P.S) and contingencies @4% of building cost.
Determine the total cost of building project.

Solution:

Data given:

Plinth area = 800m2.

Plinth area rate = Rwf. 45,000 per Sqm.

- ✓ Cost of building = 800 x 4500 = Rs. 36,000,000
- ✓ Add the cost of the water supply charges @7½% = $\frac{36,000,000*7.5}{100} = 2,700,000$
- ✓ Add the Cost of Sanitary and electrical installation @ 15% = $\frac{36,000,000*15}{100} = 5,400,000$
- ✓ Add the cost of archetectural features @1% = $\frac{36,000,000*1}{100} = 360,000$
- ✓ Add the cost of Roads Lawns @ 5%= $\frac{36,000,000*5}{100} = 1,800,000$
- ✓ Add the Cost of P.S. and contingencies @ 4% = $\frac{36,000,000*4}{100} = 1,440,000$

Total cost is 47,700,000

Example 2: The plinth area of an apartment is 500 sqm. Determine the total cost of building from the following data:

a) Rate of construction = Rwf. 24,600/per m^3.

b) The height of apartment = 16.25 m

c) Water Supply, Sanitary and Electrical installations each at 6% of building cost.
d) Architectural appearance @ 1% of building cost.
e) Unforeseen item @2% of Building cost.
f) P.S. and contingencies @4% of building.

Solution :

- ✓ The Cost of building = cubic content x cubic rate = 500 ×16.25 ×24,600 = 202,950,000
- ✓ Provision for water supply, sanitary and Electrical installations water supply and sanitation each @ 6% = $\frac{202,950,000*18}{100} = 36,531,000$

i.e total percent = 3×6 = 18% building cost

- ✓ Architectural appearance @1%= $\frac{202,950,000*1}{100} = 2,029,500$
- ✓ Unforeseen items @2% = $\frac{202,950,000*2}{100} = 4,059,000$
- ✓ P.S. and contingencies @4% = $\frac{202,950,000*4}{100} = 8,118,000$

Total Cost = 253,687,500

Example 3: The plinth area and plinth area rate of a residential building are 100 sqm and 500,000 /- respectively. Determine the total cost of building assuming suitable provisions.

Solution:

- ✓ Cost of building = 100 x 500,000 = 50,000,000
- ✓ Cost of water supply and sanitary fittings @15% = $\frac{50,000,000 \cdot 15}{100} = 7,500,000$
- ✓ Cost of Electrification @7½% = $\frac{50,000,000 \cdot 7.5}{100} = 3,750,000$
- ✓ Cost of Roads & Lawns @5%= $\frac{50,000,000 \cdot 5}{100} = 2,500,000$
- ✓ Cost of P.S. & contingencies@4%= $\frac{50,000,000 \cdot 4}{100} = 2,000,000$

Total Cost is 59,000,000

Example 4: Prepare an approximate Estimate of a proposed building from the following?

Plinth area of the building = 226 sqm.
Cost of the structure = Rwf. 25,000 per sqm.
Water supply and sanitary arrangements = 12½%
Electrification =7%
Fluctuation of rates = 5%
Petty supervision charges = 3%

Sol:

- ✓ Cost of Building = 226x 25,000 = 5,650,000
- ✓ Water supply & Sanitary arrangements @ 12½ %= $\frac{5,650,000 \cdot 12.5}{100} = 706,250$
- ✓ Electrification @7% = $\frac{5,650,000 \cdot 7}{100} = 395,500$
- ✓ Fluctuation of rates 5% = $\frac{5,650,000 \cdot 5}{100} = 282,500$
- ✓ Petty 7 supervision charges 3%= $\frac{5,650,000 \cdot 3}{100} = 169,500$

Total Cost is 7,203,750

b. Cubical content method

This method is generally used for multistoried buildings. It is more accurate than the other two methods like plinth area method and unit base method. The cost of a structure is calculated approximately as the total cubical contents (Volume of buildings) multiplied by Local Cubic Rate. The volume of building is obtained by Length x breadth x depth or height. The length and breadth are measured out to out of walls excluding the plinth off set.
The cost of building= volume of buildings x rate/ unit volume.

Examples:

Example 1 : Prepare the rough estimate for a proposed commercial complex for a municipal corporation for the following data.
Plinth Area = 500m2/floor
Ht of each storey = 3.5m
No.of storeys = G+2
Cubical content rate = 167,234 /m3
Provided for a following as a percentage of structured cost
a) Water supply & Sanitary arrangement -8%
b) Electrification -6%
c) Fluctuation of rates - 5%
d) Contractors profit - 10%
e) Petty supervision & contingencies - 3%

Sol:

- ✓ Cubical content = No.of storeys (Plinth Area x height of each storey) = 3(500x3.5)=5250m3
- ✓ Structural cost = Cubical content x cubical content rate= 5250 x 167,234= 877,978,500
- ✓ other provisions:
  - Water supply and sanitation = $\frac{877,978,500\times8}{100} = 70,238,280$
  - Electrification = $\frac{877,978,500\times6}{100} = 52,678,710$
  - Fluctuation of rates = $\frac{877,978,500\times5}{100} = 43,898,925$
  - P.S./& contingencies = $\frac{877,978,500\times3}{100} = 26,339,355$
  - Contractors Profit = $\frac{877,978,500\times10}{100} = 87,797,850$

Total Cost = 1,158,931,620

c. Unit base method

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

Examples:

Example 1: Prepare an approximate estimate or rough cost estimate of a hospital building for 50 beds. The cost of construction altogether for each bed is Rwf. 50,648,230/-. Determine the total cost of hospital building.

Solution:

- ✓ No. of beds = 50
- ✓ Cost of construction = 50,648,230*50=2,824,115,000

Total Cost of Hospital building = 2,824,115,000

Example 2: To prepare the rough cost estimate of a hostel building that accommodates 150 students. The cost of construction including all provisions is Rs. 1,500,000/- per student. Determine total cost of building.

Solution:

No.of students= 150

Cost of construction including all L.S. provisions = 1,500,000

Total Cost of hostel building =150 x 1,500,000=225,000,000

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:

a) **Details of measurements and calculation of quantities**

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

Details of measurements form

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

b) Abstract of Estimated Cost

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**.

Table 7.1 ABSTRACT OF ESTIMATED FORM

Item No.	Description of item	Quantity	Unit	Rate	Amount

Rate analysis

In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis. The rates of particular item of work depend on the following:

1. Specifications of works and material about their quality, proportion and constructional

Operation method.

2. Quantity of materials and their rates

3. Number and Cost of labors;

4. Location of site of work and the distances from source and conveyance Charges.

5. Overhead and establishment charges

6. Profit

Overhead costs- Overhead costs include general office expenses, rents, taxes, supervision and other costs which are indirect expenses and not productive expenses on the job.

The miscellaneous expenses on overheads may be under the following heads:

A - General overheads-

- Establishment (office staff),

- Stationary, printing, postages, etc…
- Travelling expenses,

- Telephone
- Rent and taxes

B- Job Overheads -

- Supervision (salary of engineers, overseers, supervision…)
- Handling of materials,
- Repairs,
- Amenities of labors
- Workman's compensation, insurance, etc…
- Interest on investment

The contactor may be allowed a net profit of 6 to 8%, and the miscellaneous overhead expenses may come to about 5 to 10%. For overhead expenses and contractor's profit 15% of the actual cost may be reasonable amount but it is usually practice to add 10% for all these under the head profit. For small works overhead cost may be very little. A provision for water charges@ 1.5 % of the total cost is made in the rate. 4% of estimated Cost is allowed for Petty Supervision, contingencies and Unforeseen items. A percentage of 1.5% to 2% is also added to meet the expenditure of work-charged establishment. The grand total thus obtained is **estimated cost** of the work.

The detailed estimate should be accompanied with:

- Report,
- specification,
- Drawings (plans, elevations, sections),
- designs charts and calculations,
- Standards schedules of rates.

Factors to be considered During Preparation of 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.

Units of dimensions for materials and works and mode of measurement for different items of works and materials

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:

- Single units work like doors, windows, trusses etc., is expressed in numbers.
- Works consists linear measurements involve length like cornice, fencing, hand rail, bands of specified width etc., are expressed in running meters (RM)
- Works consists areal surface measurements involve area like plastering, white washing, partitions of specified thickness etc.
- Works consist of cubical contents which involve volume like earth work, cement concrete; Masonry etc. are expressed in Cubic meters.

Table 7.2 Units of measurement for various items of works and materials

Item No.	Particulars of items	Unit of measurement	Unit of payment
1	Earthwork in excavation	m^3 (cum)	per m^3
2	Stone masonry	m^3	per m^3
3	Damp proof course (DPC)	m^2 (sqm)	per m^2
4	Brickwork	m^3	per m^3
5	Cement concrete (C.C) or	m^3	per m^3
6	Flooring	m^2	per m^2
7	Roof	m^2	per m^2
8	Door and window fitting	number	per number
9	Plastering, pointing, and paintin	m^2	per m^2
10	Rain water pipe	m	per m

Principles of deciding unit of measurement

The most important principles of selection of unit of measurement:

1. The unit of measurement should be simple and convenient to measure, record and understand
2. It should be one, which provides for fair payment for the work involved

3. In the result it should be yield quantities which are neither too minute nor too large
4. The price per unit should not be a very small figure or a very large one, that is generally costlier items will be measured in small units, cheaper ones in larger units
5. The unit of measurement may sometimes depend upon the unit for the raw material and / or labor and important dimensions.

Rules for measurement

The rules for measurement of each item are invariably described in IS1200. However some of the general rules are listed below.

1. 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.

2. In booking, the order shall be in sequence of length, breadth and height or thickness.

3. All works shall be measured subject to the following tolerances.
i) Linear measurement shall be measured to the nearest 0.01meter
ii) Areas shall be measured to the nearest 0.01 square meter
iii) Cubic contents shall be worked-out to the nearest 0.01 cubic meter

4. Same type of work under different conditions and nature shall be measured separately under separate items.

5. The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed.

6. In case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the heights shall be described:

a) From foundation to plinth level

b) From plinth level to first floor level

c) From First floor to second floor level and so on.

Purpose of estimating

The purpose of estimating is:

Togive a reasonable accurate ides of the cost
To give the owner a reasonably accurate idea of the cost to help him decide whether the work can be undertaken as proposed or need to be curtailed or abandoned, depending upon the availability funds and prospective direct and indirect benefits
estimating in construction is to ensure that work is carried out according to correct plan and specification
estimator must be in a position to know exactly how much expenditure is going to incur on estimating of materials, labor, plant and time
The estimator comes up with approximate cost. The actual cost of a project will be determined after completion of the project.

Meaning of technical words

- **Profit:** Amount of money which can be gotten after work completion and payment of labor.
- **Overhead:** Amount of money given on site so that the work continue more quickly
- **Contingency:**
- **Bid cost** (estimated cost): the cost obtained by adding on the cost;

  profit, overhead, and contingency.

- **Approximate cost:** the cost of a project which you need before works begin.
- **Actual cost:** the cost of a project used for completing all construction works.

Qualifications of an estimator

A good estimator should possess the following qualifications:

1. A thorough understanding of architecture drawings
2. A sound knowledge of building materials, constructions methods and customs prevailed in the trade
3. A fund of information collected or gained through experience in construction work, relating to materials required hourly, output of labor and plant, overhead expenses and cost of all things
4. An understanding of a good method of preparing an estimate
5. A systematic and orderly mind
6. Ability to do careful and accurate calculations
7. Ability to collect, classify and evaluate data that would be useful in estimating.

Steps in preparation of a detailed estimate

There are three clearly defined steps in preparation of a detailed estimate

i. Taking out quantities

In the first step of taking out quantities, the measurements are taken off from the drawing and entered on measuring sheet. The measurement to be taken out would depend upon the unit of measurement.

For example, in the case of **stone masonry** in foundation; length, thickness, and height of the trench would be taken from the drawing and entered on the measurement sheet; the unit of measurement is cubic meter **(m^3);** whereas, in the case of **plastering,** only the length and height of the wall would be entered on the measurement sheet; the unit of measurement is square meter **(m^2).**

ii. Squaring out

The second step consists of working out volumes, areas, etc., and costing up to their total in recognized units.

iii. Abstracting

In the third step, all the items along with the net results obtained in the second step are transferred from measurement sheets to specially ruled

sheets having rate column ready for pricing.

The second and third steps above are known as working up.

All calculations in these stages and every entry transferred should be checked by another person to ensure that no mathematical or copying error occurs.

Example1: estimate the quantities of brickwork and plastering in a wall 4m long, 3m height and 30 cm thick. Calculate also the cost if the rate of brickwork is Rs.320 per $m^3$and of plastering is Rs.8.50 per m^2.

Answer:

Quantity of brickwork: L x B x H = 4m x 3m x 0.30m = 3.6 m^3

Quantity of plastering (2 faces): 2 x L x H = 2 x 4m x 3m= 24 m^2

Cost of brickwork: 3.6 m^3 x 320 Rs/ m^3 = Rs.1152.0

Cost of plastering: 24 m^2 x 8.50 Rs/m^2= Rs.204.0

Total cost = Rs.1152.0 + Rs.204.0= Rs.1356.0

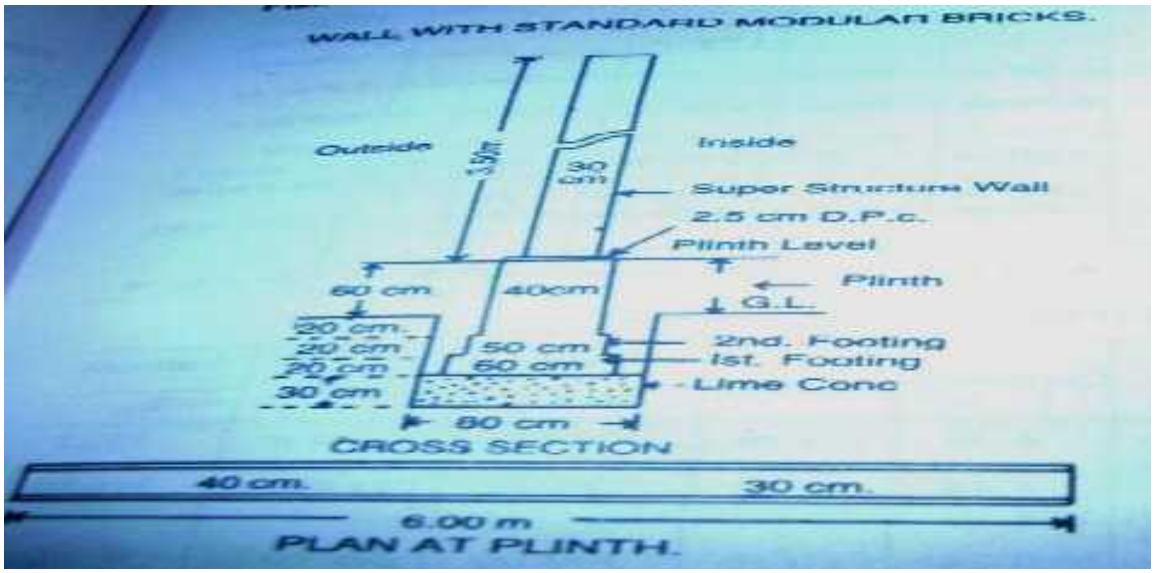
Example 2: Prepare a detailed estimate of part a wall of building from the given plan and section and general specification.

GENERAL SPECIFICATIONS

- Foundation concrete shall be of lime concrete
- Foundation and plinth shall be of 1^{st} class brickwork in lime mortar.
- Damp proof course- 2.5 mm c.c $1:1^{1/2}$:3 with water proofing compound.
- Superstructure 1^{st} class brickwork in lime mortar.
- Wall finishing –inside wall 12mm cement plastered 1:6 and white washed 3coats.

Outside wall 12mm cement plastered 1:6 including 10 cm below ground level and finished with two coats of colour over one coat of white washing. Assume local current rates.

Plan and section of the building are shown below.



SOLUTION

Detailed estimate of measurement and calculation of quantities

Sno.	Description of items	No				Quantities
1	Earthwork in excavation in foundation	1	6m	0.8m	0.9m	4.32 cu.m
3	1st class brickwork in					
	1st footing	1	6m	0.6m	0.20m	0.72
	2nd footing	1	6m	0.5m	0.2m	0.60
	Plinth wall up to GL	1	6m	0.4m	0.2m	0.48
	Plinth wall above GL	1	6m	0.4m	o.6m	1.44
4	2.5 cm damp proof course c.	1	6m	0.40m	-	2.4 sq.m
5	First class brickwork in lllllimemortar for	1	6m	0.3m	3.5m	6.3cu.m
6	12mm plaster of cement san d Inside Outside including 10cm below GL	1 1	6m 6m	- -	3.5m 4.2m	21sq.m 25.0sq.m
8	Colour washing 2coats ove one coat of white washi (outside above GL)	1	6m	-	4.1m	24.6

Abstract of estimated cost

Items No	Description	quantity	unit	Rate Rs.	Amount Rs.
1	Earthwork in excavation in foundation	4.32	Cu.m	350.0	15.12
2	Lime concrete in foundation	1.44	Cu.m	220.0	316.80
3	1^{st} class brickwork in lime mortar in foundation and plinth	3.24	Cu.m	300.0	972.0
4	2.5 cm damp proof course c.c $1:1^{1/2}:3$	2.4	Sq.m	20.0	48.0
5	First class brickwork in lime mortar for Superstructure	6.3	Cu.m	320.0	2016.0
6	12mm plaster of cement sand 1:6	46.0	Sq.m	8.50	392.70
7	White washing 3coats (inside)	21.0	Sq.m	0.75	15.75
8	Colour washing 2coats over one coat of white washing	24.6	Sq.m	0.82	20.17
				Total	3796.54
				Add for contingencies 3%	113.90
				Add for work charged establishment 2%	75.93
				Grand total	3986.37

METHODS OF TAKING OUT QUANTITIES

The quantities like earthwork, foundation concrete, brickwork in plinth and Superstructure etc., can be workout by any of following two methods:

a) Long wall - short wall method
b) Centre line method.
c) Partly Centre line and short wall method.

a) Long wall-short wall method

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

b) Centre line method

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

c) Partly centre line and partly cross wall method

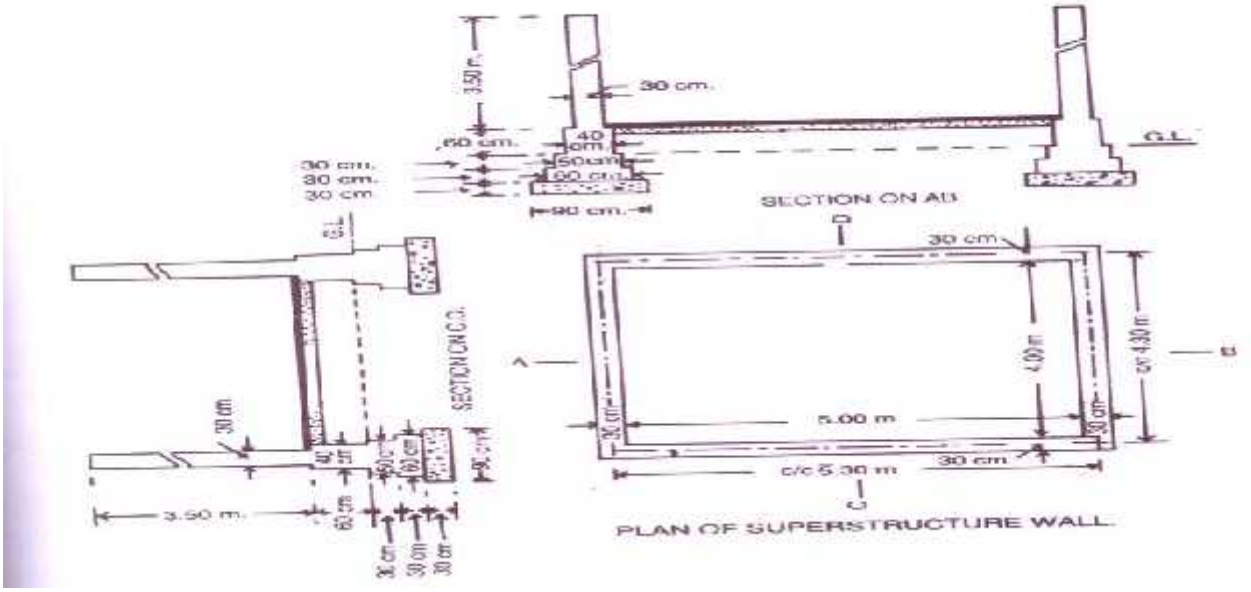
This method is adopted when external (i.e., all-round the building) wall is of one thickness and the internal walls having different thicknesses. In such cases, centre line method is applied to external walls and long wall-short wall method is used to internal walls. This method suits for different thicknesses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

EXAMPLES:

Example 1: The plan presents the plan of superstructure wall of single room building of 5m x 4m, and sections represent the cross-sections of the walls with foundation. Estimate by using long and short wall method and center line method the quantities of:

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

The length of long wall centre to centre = 5.00 + ½ × .30 + ½ × .30 = 5.30 m. The length of short wall centre to centre = 4.00 + ½ × .30 + ½ × .30 = 4.30 m.



SOLUTION

1. Long and short wall method

Details of measurement and calculation of quantities

Item No.	Description of item	No.	Length	Breadth	Height	quantity	Explanatory notes
1	Earthwork in excavation						
	Long wall	2	6.20m	0.90m	0.90m	10.04	L= 5.3+0.90
	Short wall	2	3.20m	0.90m	0.90m	5.51	B=4.3-0.90
					Total	15.55m3	
2	Concrete in foundation						
	Long wall	2	6.20m	0.90m	0.30m	3.35	L= same as
	Short wall	2	3.40m	0.90m	0.30m	1.83	above
					Total	5.18m3	
3	Brickwork in foundation and plinth						
	Long walls						
	1st footing	2	5.90m	0.60m	0.30m	2.13	L=5.3+0.6
	2nd footing	2	5.80m	0.50m	0.30m	1.74	L= 5.3+0.5
	Plinth walls	2	5.70m	0.40m	0.60m	2.74	L=5.3+0.40
	Short walls						
	1st footing	2	3.70m	0.60m	0.30m	1.33	L=4.3-.60
	2nd footing	2	3.80m	0.50m	0.30m	1.14	L=4.3-50
4	Brickwork in superstructure						
	Long Walls						
	Short walls	2	5.60m	0.30m	3.50m	11.76	L=5.3+0.30
		2	4.0m	0.30m	3.50m	8.40	L=4.3-0.30

2. Center line method

Long wall centre to centre length = 5m+ 0.15m +0.15m= 5.3m
Short wall centre to centre length = 4m+ 0.15m +0.15m= 4.3m
Total centre line length = 2(5.3m+ 4.3m) = 19.2m

Details of measurement and calculation of quantities

Item No.	Description of item	No.	Dimension			Quantity	unit	Explanatory notes
			L	B	H			
1	Earthwork in Excavation	1	19.2	0.9	0.9	15.552	cu.m	Total centre line length= 19.2m
2	Lime concrete in Foundation	1	19.2	0.9	0.3	5.184	cu.m	
3	Brickwork in foundation and plinth							
	1st footing	1	19.2	0.6	0.3	3.456	cu.m	
	2nd footing	1	19.2	0.5	0.3	2.88	cu.m	
	plinth wall	1	19.2	0.4	0.6	4.608	cu.m	
4	Brickwork in Superstructure	1	19.2	0.3	3.5	20.16	cu.m	

Example 2: Estimate the quantities of the following items of two roomed building from the given plan and section by using long and short wall method, and centre line method:

1. Earthwork in excavation in foundation,
2. Lime concrete in foundation,
3. 1^{st} class brickwork in cement mortar 1:6 in foundation and plinth,
4. 2.5 cm c.c damp proof course, and
5. 1^{st} class brickwork in lime mortar in superstructure.

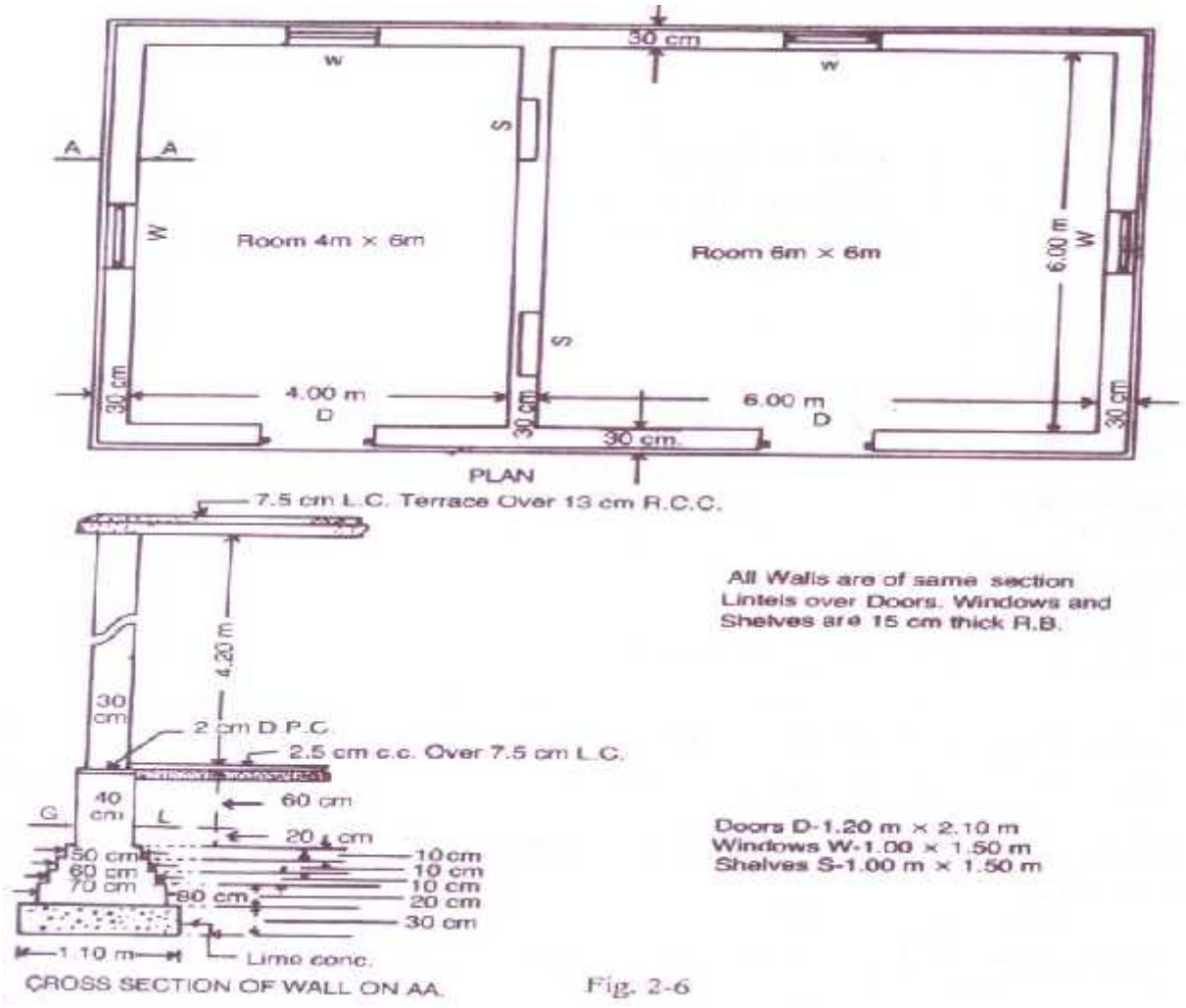


Fig. 2-6

SOLUTION

1. Long and short wall method

Long wall centre to centre length = 4m+ 6m+ 0.3m+ 0.15m +0.1m = 10.6m

Short wall centre to centre length= 6m +0.15m + 0.15m =6.3m

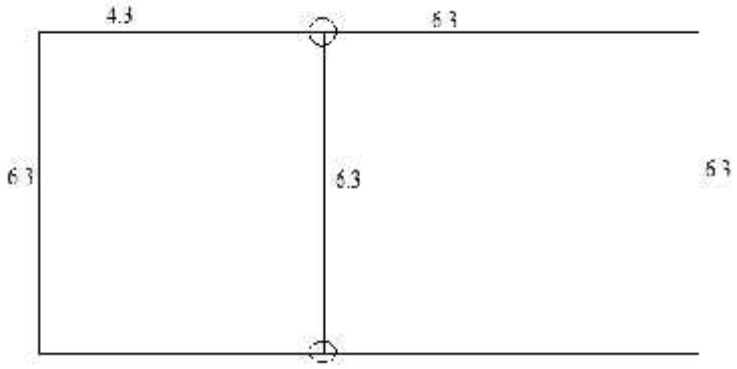
Details of measurement and calculation of quantities

Item No.	Description	No.	Dimension			Quantity	unit	Explanatory notes
			L	B	H			
1	Earthwork in excavation in foundation							
	Long Wall	2	11.7	1.1	1	25.74	cu.m	L=10.6+ 1.1= 11.7
	Short Wall	3	5.2	1.1	1	17.16		L=6.3-1.1= 5.2
2	Lime concrete in foundation							
	Long Wall	2	11.7	1.1	0.3	7.722	cu.m	same as above
	Short Wall	3	5.2	1.1	0.3	5.148	cu.m	same as above
3	1st class brickwork in 1:6 cement mortar in foundation and plinth							
	Long Wall							
	1st footing	2	11.4	0.8	0.2	3.648	cu.m	L= 10.6+0.8= 11.4
	2nd footing	2	11.3	0.7	0.1	1.582	cu.m	L=10.6+0.7= 11.3
	3rd footing	2	11.2	0.6	0.1	1.344	cu.m	L= 10.6+0.6= 11.2
	4th footing	2	11.1	0.5	0.1	1.11	cu.m	L=10.6+0.5= 11.1
	Plinth wall above footing	2	11	0.4	0.8	7.04	cu.m	L= 10.6+0.4=11
	Short Wall							
	1st footing	3	5.5	0.8	0.2	2.64	cu.m	L= 6.3-0.8=5.5
	2nd footing	3	5.6	0.7	0.1	1.176	cu.m	L=6.3-0.7= 5.6
	3rd footing	3	5.7	0.6	0.1	1.026	cu.m	L=6.3-0.6=5.7
	4th footing	3	5.8	0.5	0.1	0.87	cu.m	L=6.3-0.5= 5.8
	Plinth wall above footing	3	5.9	0.4	0.8	5.664	cu.m	L=6.3-04= 5.9
4	Damp proof course 2.5 cm c.c							
	Long Wall	2	11	0.4		8.8	sq.m	same as plinth
	Short Wall	3	5.9	0.4		7.08	sq.m	same as plinth
	Deduct door sills	2	1.2	0.4		0.96	sq.m	
	Net Total					15.88	sq.m	
5	1st class brickwork in 1:6 cement mortar in superstructure							
	Long Wall	2	10.9	0.3	4.2	27.468	cu.m	L= 10.6+0.3=10.9
	Short Wall	3	6	0.3	4.2	22.68	cu.m	L= 6.3-0.3=6
	Deduct							
	Door opening	2	1.2	0.3	2.1	1.512	cu.m	
	Window	4	1	0.3	1.5	1.8	cu.m	
								10cm back of
	Lintel over doors	2	1.5	0.3	0.15	0.135	cu.m	15cm bearing
	Lintel over window	4	1.3	0.3	0.23	0.3588	cu.m	15cm bearing
	Lintel over Shelves	2	1.3	0.3	0.15	0.117	cu.m	15cm bearing
	Total deduction					4.5228	cu.m	
	Net Total					45.625	cu.m	

2. Centre line method

Centre line length for long wall= 4m+2(0.15m)+6m+2(0.15m)= 10.6m
Centre line length for short wall= 6m+ 0.15m+ 0.15m = 6.3m
Total Centre line length of wall = 2x 10.6+ 3x 6.3 = 40.1m
Number of T-junction=2

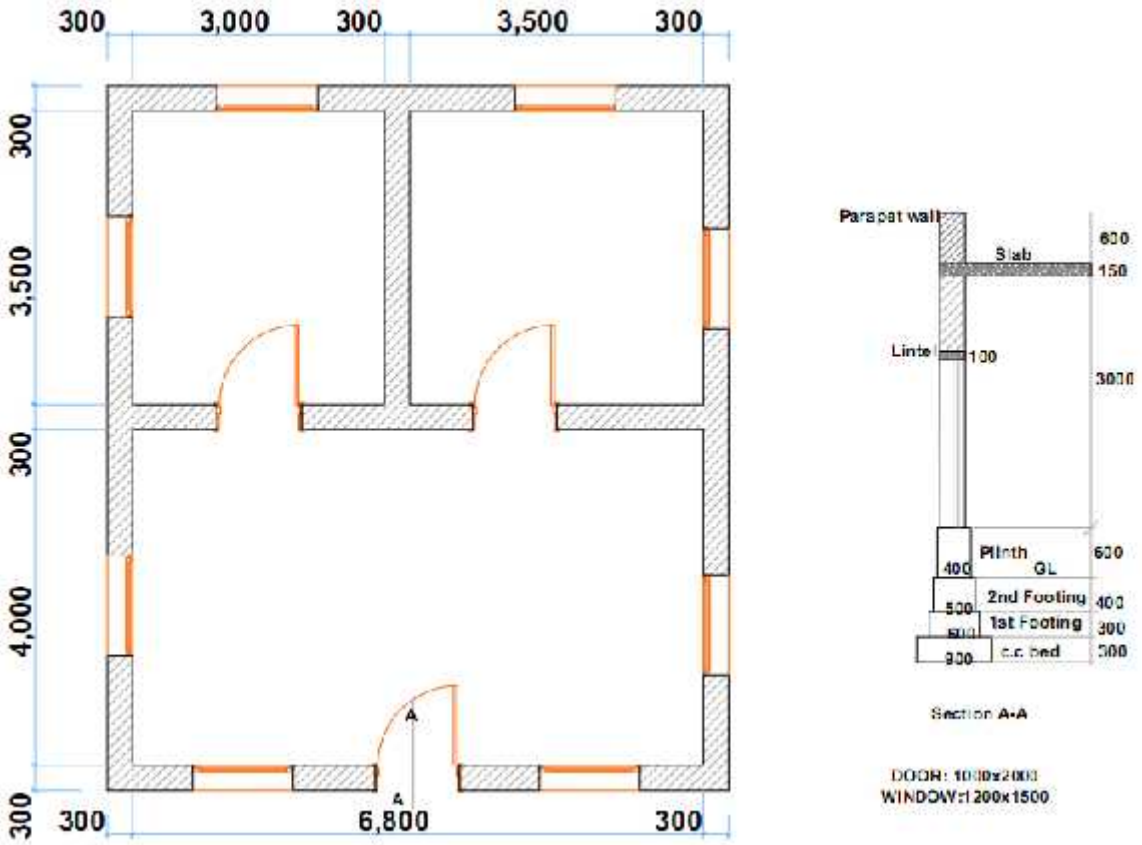
Centre line diagram



Details of measurement and calculation of quantities

Item No.	Description of item	No.	Dimension			Quantity	Unit	Explanatory note
			L	B	H			
1	Earthwork in Excavation	1	39	1.1	1	42.9	cu.m	L= 40.1- 2*1.1/2= 39
2	Lime concrete	1	39	1.1	0.3	12.87	cu.m	same as above
3	1st class brickwork in 1:6 cement mortar in foundation and plinth							
	1st footing	1	39.3	0.8	0.2	6.288	cu.m	L=40.1-2*0.8/2= 39.3
	2nd footing	1	39.4	0.7	0.1	2.758	cu.m	L= 40.1- 2*0.7/2= 39.4
	3rd footing	1	39.5	0.6	0.1	2.37	cu.m	L= 40.1-2*0.6/2= 39.5
	4th footing	1	39.6	0.5	0.1	1.98	cu.m	L= 40.1- 2* 0.5/2= 39.6
	plinth wall above footing	1	39.7	0.4	0.8	12.704	cu.m	L= 40.1- 2*0.4/2= 39.7
4	Damp proof course	1	39.7	0.4		15.88	sq.m	same as plinth wall
	Deduct sill	1	1.2	0.4		0.96	sq.m	
	Net total					14.92	sq.m	
5	1st class brickwork in 1:6 cement mortar in superstructure							
		1	39.8	0.3	4.2	50.148	cu.m	L=40.1-2*0.3/2= 39.8
	Deduct							
	Door opening	2	1.2	0.3	2.1	1.512	cu.m	
	Window	4	1	0.3	1.5	1.8	cu.m	
	Shelves	2	1	0.2	1.5	0.6	cu.m	10cm back of shelve
	Lintel over doors	2	1.5	0.3	0.15	0.135	cu.m	15cm bearing
	Lintel over window	4	1.3	0.3	0.23	0.3588	cu.m	15cm bearing
	Lintel over Shelves	2	1.3	0.3	0.15	0.117	cu.m	15cm bearing
	Total deduction					4.5228	cu.m	
	Net Total					45.625	cu.m	

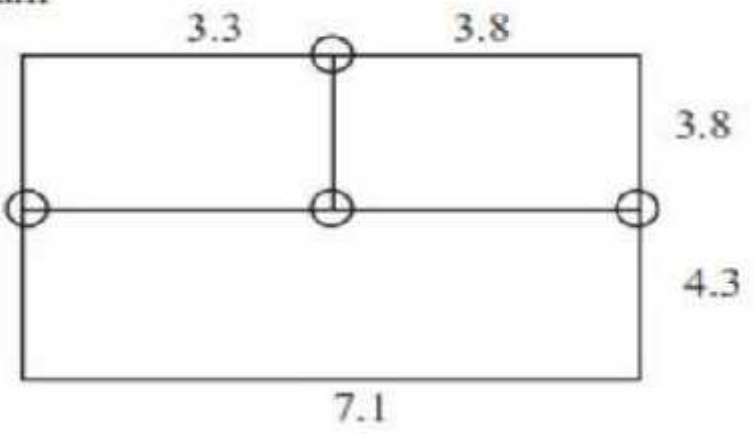
Example3. From the given figure below calculate the details estimate for the single storied residential building by Centre Line Method.



SOLUTION

Centre line diagram

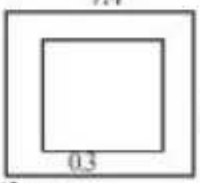
Centre line diagram



Total centre line length =(3.3+3.8)3+3.8×3+4.3×2=41.3m

no of T Junctions = 4

S.No.	Particulars of Items	No.	L	B	H	Q	Explanation
1.	Earth work Excavation	1	39.5	0.9	1.0	35.55	41.3-4x0.9/2=39.5
2.	C.C. bed (1:5:10)	1	39.5	0.9	0.3	10665	m^3
3.	R.R. Masonary in CM 1:6						
	1st Footing	1	40.1	0.6	0.3	7.218	41.3-4x0.6/2=40.1
	IInd Footing	1	40.3	0.5	0.4	8.06	41.3-4x0.5/2=40.3
	Plinth	1	40.5	0.4	0.6	9.72	41.3-4x0.4/2=40.5
					Total	**25.00**	m^3
4.	Damp proof course over basement around the building with CC (1:2:4)	1	40.5	0.4	- - -	16.2	m^2
5.	First class brick work in wall in						
	a) superstructure with CM 1:6	1	40.7	0.3	3.0	36.63	L =41.3-4x0.3/2
	b) Parapet wall	1	30.4	0.3	0.6	5.472	L=2(7.1+8.1)
					Total	**42.102**	m^3
	Deductions:						
	Doors	3	1.0	0.3	2.0	1.80	
	Windows	8	1.2	0.3	1.5	4.32	
	Lintel opening over						
	Doors	3	1.2	0.3	0.1	0.108	Asue 100mm
	Windows	8	1.4	0.3	0.1	0.336	projection on either
					Total	**6.564**	side
	Net Quantity of BM = 42.102-6.564 = 35.538m^3						
6.	Plastering with 12mmth in CM 1:5	1x2	40.1	---	3.0	240.6	L=41.3-4x0.3=40.1
	Deductions for openings						



S.No.	Particulars of Items	No	L	B	H	Q	Explanation
	Doors	3x2	1.0	---	2.0	12.0	
	windows	8x2	1.2	---	1.5	28.8	
					Total	**40.8**	m^2
	Plastering for parapet wall (sides)	1x2	30.4	---	0.6	36.48	
	Top	1	30.4	0.3	---	9.12	
					Total	**45.60**	m^2
	Net Plastering = 240.6-40.8+45.6 = 245.4 m^2						
7.	Flooring with 25mmth CC(1:2:4)						
	Kitchen	1	3.0	3.5	--	10.5	
	Bed	1	3.5	3.5	--	12.25	
	Hall	1	6.8	4.0	--	27.20	
	Sills of Doors	3	1.0	0.3	--	0.90	
8.	Ceiling = Same as				Total	**50.85**	m^2
	Flooring					50.85	m^3
9.	white washing = Same as Plastering for walls and ceiling 245.4+50.85 = 296.25 m^2						
10.	RCC(1:2:4) for						
	a) Slab	1	7.40	8.40	1.5	9.324	
	b) lintels over Doors	3	1.2	0.3	0.1	0.108	
	Windows	8	1.4	0.3	0.1	0.336	
	c) beams	1	40.7	0.3	0.3	3.663	
					Total	**13.431**	m^3
11	Supply & Fixing of best country wood for						
	a) Doors	3				3Nos.	
	b) Windows	8				8 Nos	
12	Painting with ready mixed synthetic enamil paints two coats over primary coat for new wood for						
	a) Doors	2¼x3	1.0	--	2.0	13.50	
	b) Windows	2¼x8	1.2	--	1.5	32.40	
						45.90	m^2
13	2% unforeseen items						
14	4% P.S& contingencies and round off.						

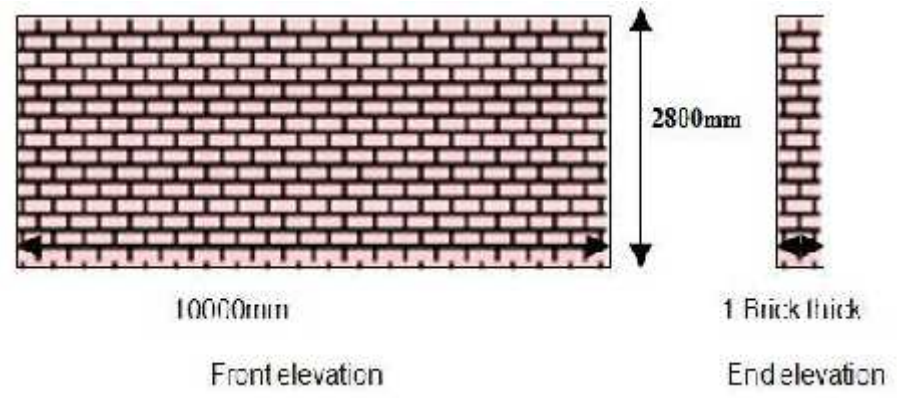
WORKED EXAMPLES

1. Calculate the number of bricks of 20×9.5×7 cm and the quantity of mortar in a wall of 8m long, 2m height and 20cm thick.

2. Estimate the quantities of brickwork and plastering in a wall 4m long, 3m height and 30 cm thick. Calculate also the cost if the rate of brickwork is 320 dollars per m^3 and of plastering is 8.50dollars per m^2

3. Calculate the number of bags of cements in 2, 1 m^3 of cement sand mortar if the ratio is 1:5 and one bag of cement occupies 0.035m^3

4. Estimate the quantities of bricks of 215mmx65mm in the following wall



5. Read carefully the following bill of quantity and Replace letters in parentheses from (a) to (t) by their corresponding values or words.

Item No	Description of item	(a)	Unit	(b) in Rwf/unit	(c) in Rwf
1	Earthwork in excavation in foundation	11.42	…(d)…	2,000.00	…(e)…
2	Earthwork in filling	42.15	…(f)…	…(g)…	115,500.00
3	Cement concrete in foundation	…(h)…	m^3	80,000.00	717,200.00
4	Stone masonry in foundation and plinth	21.42	…(i)…	50,000.00	642,600.00
5	12mm sand plastering (1:6)	…(j)…	…(k)…	1,500.00	32,340.00
6	2.5cm damp proof course	8.18	m^2	…(l)…	14,688.00
7	Single metal door(90*240)	2	…(m)...	100,000.00	200,000.00
8	First class brick work 1:6	31.85	..(n)…	60,000.00	…(o)…
			Total		…(p)…
			Add 3% of contingencies		…(q)…
			Add 2% of work charged establishment		…(r)…
			Grand Total		…(s)..

We say ……(t)…….. francs

L.U 2: DETERMINE REQUIRED RESOURCES

L.O.2 IDENTIFY THE QUALITY OF MATERIALS

To identify the quality of material needed you have to identify the following items:

a. Specification of materials
b. Description of Materials
c. Materials testing

L.O.2.3 DETERMINE HUMAN RESOURCES

Factors for Human resources determination:

- ✓ Variety of task
- ✓ Extent of work
- ✓ Duration of work
- ✓ Emergency of work
- ✓ Working place

Labor classification

- ✓ Skilled 1st class
- ✓ Skilled 2nd class
- ✓ Unskilled

The lab our charges can be obtained from the standard schedule of rates 30% of the skilled labour provided in the data may be taken as Ist class, remaining 70% as II class. The rates of materials for Government works are fixed by the superintendent Engineer for his circle every year and approved by the Board of Chief Engineers. These rates are incorporated in the standard schedule of rates.

Note: For $1m^3$ wet concrete = $1.52m^3$ dry concrete approximately specific weight of cement= 1440 kg/m^3 (or) 1.44 t/m^3 1 bag of cement = 50 Kg

Example 1:- Calculate the Quantity of material for the following items.

a) R.C.C. (1:2:4) for $20m^3$ of work
b) R.C.C. (1:3:6) for $15m^3$ of work

Example 2:- Calculate the quantity of materials for the following items.

a) C.M. (1:4) for $1m^3$ of work
b) CM (1:6) for $1m^3$ of work

S.N	Description of item	Quantity
1	Brickwork in lime or cement mortar in foundation and plinth	1.25 cu.m (per mason)
2	…….. In superstructure	1 cu.m
3	Brickwork in mud mortar in foundation and plinth	1.5 cu.m
4	…….. In superstructure	1.25 cu.m
5	Lime Concrete in Foundation or fl	8.5 cu.m
6	Cement Concrete 1:2:4	5 cu.m

7	Pointing with cement or lime mortar	10 sq.m
8	White washing or colour washing three coats	70 sq.m

L.U.3 CALCULATE THE COST ESTIMATION

L.O 3.1 ACTUALIZE THE PRICES

Before deciding any price for any items it is recommended t perform survey on current prices on the market, and some of the surveys conducted are the following:

- ✓ Material survey prices
  (Window shopping comparison)
  Perform invoice
- ✓ Human resources survey price
  (Window shopping comparison)
- ✓ Equipment survey price
  (Window shopping comparison)
- ✓ Transport survey price
  (Window shopping comparison)

Price survey methodology

- ✓ Performa format
- ✓ Surveys templates

L.O.3.2.DETERMINE THE UNITS AND TOTAL COST OF MATERILAS

To find out the quantities of any items in construction it is recommended to have the international unit to express that quantity ,then deduce the cost per unit of measurements

- ➢ Per cubic meter
- ➢ Per linear meter
- ➢ Per square meter
- ➢ Per unit of mass
- ➢ Per pieces
- ➢ Lump sum

Total cost

The total cost is usually equal to unit price x quantity of each item

L.O.3.3 PERFORM CALCULATION OF CHARGES AND BENEFITS

Calculation of charges and benefits/Price per unit breakdown:

To establish the grand total for any project you must first calculate the total cost and associate to its other cost that will not be classified among material cost and some of these cost are :

- ✓ Labor cost
- ✓ Maintenance cost
- ✓ Taxes
- ✓ Equipment
- ✓ Benefits
- ✓ Transport
- ✓ Other unforeseen charges

Hence the grand total cost of the project is the sum of these listed above items plus the total cost of materials

Bill of quantities

In order to represent clear how you find out the cost of each items it is necessary to represent it in table form and that table is known as bill of quantities or simple **(B O Q**).

This is simple form of bill of quantity

S/N	Description of items	No	Length	Breadth	Height	Quantity	Rate/unit	Total cost	Explanatory notes

L.O.3.4 FILL IN BILL OF QUANTITY

Types of bill of quantity:

- ✓ Firm bill of quantities: used to obtain lump sum price of a project
- ✓ Approximate bill of quantities: contain provisional quantities
- ✓ Specified bill of quantities: contain items and its specification

Bill of quantity contents:

- ✓ Item number

- ✓ Item description
- ✓ Unit of measures on each item
- ✓ Quantity of each item

Main purpose of bills of quantity

- ➢ Enable all contractors tendering for contract to price on exactly the same information with minimum effort.
- ➢ Allow for better comparison
- ➢ Ordering of materials
- ➢ Cost analysis for use in future
- ➢ Reference particularly on site during construction
- ➢ Planning and progressing by the contractors' site planer.
- ➢ Final accounting
- ➢ Quality by reference to the technical specifications

L.O.3.5 PREPARE AN INVOICE

Types of Invoices

If you're like many small business owners, you send customers bills after you provide a product or service. An effective invoicing system gives customers more flexible payment options. You need to know which types of invoices to send customers for different situations.

Types of invoices

There are many different types of invoices you can send to customers. Each type of invoice has a specific purpose. The following are six types of invoices in accounting that you might send to customers.

1. Pro forma invoice

A pro forma invoice is not a demand for payment. You can think of this document like a pre-invoice. You send a pro forma invoice before completing work for a customer.

The pro forma invoice shows the customer how much to pay you once you deliver a product or perform a service. You can also use a pro forma invoice to show the value of items you give away, such as a gift.

Usually, a pro forma invoice estimates the work you will do and how much items will cost. The pro forma invoice represents a commitment to provide something. The terms in a pro forma invoice can change as the project proceeds.

2. Interim invoice

An interim invoice breaks down the value of a large project into multiple payments. You send interim invoices as you complete the large project.

The larger the project, the more you spend on labor, materials, and other operating costs. Interim invoices help you manage your small business cash flow for large jobs. You don't have to wait until the end of the project to receive payments. Instead, you can use money from interim invoices to cover some of the costs.

3. Final invoice

As the name implies, you send a final invoice after you complete a project. The final invoice lets the customer know the work is done. Unlike a pro forma invoice, the final invoice is a demand for payment.

Your final invoice should include an itemized list of the products and services you provided. You should also note the total cost, due date, and payment methods.

Be sure to send final invoices immediately via mail or online after completing work. That way, you can keep cash flowing into your business at a healthy rate and avoid collections problems.

4. Past due invoice

Sometimes, your customers don't pay you by the due date on the final invoice. When this occurs, you need to send a past due invoice. Send past due invoices immediately after an invoice becomes late.

A past due invoice reminds customers that their payment due dates have passed. Include all the information from the final invoice on the past due invoice. Also, include any late fees or interest penalizing the customer for paying late.

If past due invoices don't work, you might have to take a different approach for customers who won't pay. Consider changing your payment terms, setting up a payment plan, or hiring a collections agency.

5. Recurring invoice

Use recurring invoices to bill customers for ongoing services. You charge the same amount periodically, similar to some utility bills.

Using a recurring invoicing system works well for subscription-based businesses. And, you could use recurring invoices if your customers have memberships to your company. For example, if you own a gym and members pay a monthly fee, recurring invoices might be the best billing option.

Entrepreneur Renzo Costarella explained recurring invoices in a Due.com article:

“When you have on-going projects with the same client, it’s often best to use a recurring invoice. With these you and the client will agree upon a billing interval (usually weekly or monthly) and the invoices will automatically bill at the set interval. The client will eventually make this part of their routine, which gets you paid quicker.”

6. Credit memo

Instead of charging a customer, you use a credit memo to acknowledge that you owe them money. The credit memo will be equal to or less than the amount of the customer’s original invoice.

You might send a credit memo because your customer returned goods, products you sent were damaged, or you sent the wrong item. With a credit memo, you can refund the amount the customer originally paid or offer credit to your customer on a future purchase.

7. **MISCELLENEOUS INVOICE**

8**. ADVANCE INVOICE**

Creating an invoice

Each type of invoice has its own unique purpose. But, usually, invoices contain the same key information. Make sure your invoices include the following items:

Date of the invoice: Let customers know which day you created the invoice.

Customer contact information: Customers want to be sure the invoice is intended for them. State the customer’s name, business, address, and phone number.

Your business’s information: Customers need to be able to reach you. Include your name, business, address, email address, and phone number on the invoice.

Items purchased: Create an itemized list of each product and service you provided. Next to each item, write the individual cost.

Total amount due: State the total payment amount you expect to receive from the customer.

Payment terms: Note the date you expect to be paid by. Also, detail how you want the customer to pay you. For example, do you accept checks, credit cards, or cash? Is there a specific address where customers should send payments? Clear invoice payment terms make it easy for customers to pay.

Invoice number: Number each invoice for your records. Make a note of the invoice number so that you can match it to payments in the future.

Elements of an invoice

- ✓ Standout Header
- ✓ Invoice number
- ✓ Company's information
- ✓ Date
- ✓ Goods or service sold
  - Item name or title of service
  - Price of the item/service
  - Amount or quantity of product or service
  -
- ✓ Fees
- ✓ Total amount due
- ✓ Terms of transaction
- ✓ A unique message
- ✓ Due date

FUNCTION OF AN INVOICE

- ✓ Maintaining records
- ✓ Payment tracking
- ✓ Legal protection
- ✓ Easy tax filling
- ✓ Business analytic
- ✓ Facilitation of inspection
- ✓ Easy preparation of sold account

Example of an invoice

Smithville Maintenance Services
35 Smith Rd
North Smithville
2145

Invoice

075 3254 25142
C124 2142 124

2542511254

me@smithvilleservices.com
www.SmithvilleServices.com

Date: Friday, 25 February 2011

Invoice Number:	3

To:
Great Outdoor Life
235 Hume Hwy
South Smithville
21524

Reference: SUPPLY OF OUTDOOR SETTINGS

Qty	Description	Unit Price	TAX	Totals
2	4 Foot Table	102.00	10.20	224.40
4	4 Foot Bench Seat	62.00	6.20	272.80

Total Excluding TAX and TAX	$	452.00
Total Price Includes TAX of	$	45.20
Total Price Includes TAX of	$	0.00
TOTAL AMOUNT PAYABLE THIS INVOICE:	**$**	**497.20**

INVOICE

APC Supply
4883 Dressler Rd NW
Canton, OH 44718
(877) 968-7147

John's Tree Service
John Doe
100 Main Street NW
Cleveland, OH 44115

Invoice #: 1
Date: 7/20/2017
Due Date: 7/20/2017

DESCRIPTION	QUANTITY	PRICE	SALES TAX	AMOUNT
Grass Seed	10.00	$5.00	Yes	$50.00

SUBTOTAL:	$50.00
SALES TAX:	$0.00
TOTAL:	$50.00
BALANCE DUE:	$50.00