# UNIT 1

# SPECIFICATION AND SPECIFICATION WRITING

## INTRODUCTION

A specification is a specific description of a particular subject. An engineering specification contains detailed description of all workmanship and materials which are required to complete an engineering project in accordance with its drawings and details.

The technical drawings of a structure will show the proportions and relative positions of the various components of the structure. Many a time it is not possible to furnish the information on the drawings, regarding the quality of materials to be used and the quality of workmanship to be achieved during construction, due to shortage of space.

This data regarding the materials and workmanship is conveyed in a separate contract document which is known as the specifications for the work. Thus the drawings with the specifications will completely define the structure. The specification is furnished separately along with drawings and is an essential part of the engineering contracts.

## NECESSITY/IMPORTACE OF SPECIFICATION

i. The cost of a unit quantity of work is governed by its specification.

ii. Specifications of a work are required to describe the quality and quantity of different materials required for a construction work and is one of the essential contract documents.

iii. This also specifies the workmanship and the method of doing the work.

iv. A work is carried out according to its specification and the contractor is paid for the same.

v. As the rate of a work is based on specification a contractor can calculate the rates of various items of work in a tender with his procurement rates of materials and labours.

vi. Specification is necessary to specify the equipment"s, tools and plants to be engaged for a work and thus enables to procure beforehand.

vii. The necessity of specification is to verify and check the strength of materials for a work involved in a project.

viii. Specification is an essential contract document and is required for arbitration and court cases.

## HOW TO WRITE SPECIFICATON / PRINCIPLES OF SPECIFICATION WRITING

While writing the specification the following principles shall be adopted.

**i. Description of materials:**

The quality and size of materials required to do an item of work shall be fully described for checking up at site according to the bindings provided in the specification. The proportion of mixing or treatment of materials if required before use shall be clearly described.

**ii. Workmanship:**

Complete description of workmanship, the method of mixing to the proportion, the method of laying, preparation of base or surface, compaction, finishing and curing etc. specifically applicable to the item of work shall be clearly stated in different clauses.

**iii. Tools and plants (T & P):**

The tools and plants to be engaged to carry out a work shall be described. The method of operation and by whom to be supplied shall be stated.

**iv. Protection of new work:**

The method of protection of new work against damage or the method of curing if required, the test of completed work if necessary shall be described in separate clauses.

**v. Expression:**

While writing a specification endeavor shall be made to express the requirements of the specifications clearly and in concise form avoiding repetition and unusual words. The style of tense shall remain same throughout. The sentences shall be short and concise. Words having more than one meaning shall be avoided.

vi. **Clauses of specifications:**

As far as possible, the clauses shall be arranged in the order in which work shall be carried out. This does not mean to follow the works according to the order of arrangements, but if facilitates reference.

## PURPOSE OF SPECIFICATION:

1. The cost of a unit quantity of work is governed by its specification.
2. A work is carried out according to its specification and the contractor is paid for the same. Any change in specification changes the tendered rate.
3. The necessity of specification is to verify and check the strength of materials for a work involved in a project.
4. Specification is an essential contract document and is required for Arbitration or court cases.
5. Specification is necessary to specify the equipment"s, tools and plants to be engaged for a work and thus enables to procure them beforehand.

## TYPES OF SPECIFICATION

The specifications can be broadly classified as:

- General specification
- Detail specification
- Contract specifications
- Standard specification
- Special specification
- Open or manufacturer's specification

i. **General specifications**:

In general specifications, nature and class of works names of materials and proportion that should be used in the various items of works are described. Only a brief description of each and every item is given. It is useful

for estimating the project. But they do not form the part of the contract document.

ii. **Detail Specification**

The detailed specifications describe the item of work in details, accurately and complete in all respects in relation to the drawings of the works. Detailed specification for a particular item specify the qualities, quantities and proportion of the materials and the method of preparation and execution and mode of measurements for that particular item of work in a project. The method and duration of protection of finished works as required are specified in the detailed specifications. The detailed specifications are arranged in the same sequence of order as the work carried out. The detailed specifications form an important part of contract document.

iii. **Contract specification**

The specifications written for a particular construction project given contract to accompany the detailed drawings are called contract specifications or project specifications.

iv. **Standard specification**

Preparation of detailed specification for an item is a time and labor extensive job. Also, there are scopes for deviations and omissions while writing lengthy specifications. Thus, the standardized specifications for most of works are prepared by the engineering department which serves as a standard guide to the department. These standard specifications are numbered. After standardizing specifications, it is not necessary to write detailed specifications, with all the contract documents. While preparing the contract document only the serial number of standard specifications is written. This saves time, labor and other expenditures.

v. **Special specification**

Some items that are not covered or work not well covered by the departmental standard specifications, special specifications for such items are drawn up by engineer-in-charge approved and included in the tender paper under a heading special specifications.

vi. **Open or manufacturer's specification**

Open specification/manufacturer's specification is specifications of products of manufacturers which state both physical and chemical properties and such other information of the product but not description of workmanship to be achieved during construction. The physical properties specify mainly the strength weight thickness or size and such other physical properties of the product. The chemical properties specify mainly the composition of chemical contents of the product and the precautionary measures if any required for storing the product.

## ADVANTAGES AND DISADVANTAGES

**Advantages of Open specification:**

i. When procurement of materials are not restricted among a few traders with their respective trademarks and any trader can supply materials satisfying the open specifications, progress of works does not suffer due to short supply of materials.

ii. Due to open specifications materials can be produced at competitive rate.

iii. Regional or local manufacturer can take the advantage to manufacture the material as a result the transportation charge and delivery time may be reduced.

iv. Due to open specification, the quality of material is standardised and, as a result, private parties can easily select a material depending on its quality.

**Disadvantages of Open specification:**

i. Frequent checking of materials of various manufacturers becomes necessary. But checking of properties is mainly done from government test laboratories. Due to heavy rush from different manufacturers the result of test reports are delayed. As a result procurement order to new manufacturer cannot be placed timely.

ii. Due to limitations of open specifications interests for further improvements of quality of materials is hampered.

iii. New manufacturers may revive the order offering very low rates but after a short supply may fail to supply or maintain the quality of materials throughout the supply period.

## RESTRICTED SPECIFICATIONS

In restricted specifications the material for an item of work is described and the procurement among some approved manufacturers or brands of the material is restricted. Thus the standard material"s such as for [plumbing, painting, fittings etc.., are assured to be of a certain degree of quality up to the satisfaction of the owner. The materials of the approved manufacturers should be equivalent in quality and more or less as per cost. To provide restricted specification for materials and up-to-date knowledge of the market for the qualities and cost of different manufacturers is essential.

## ESSENTIAL REQUIREMENTS OF SPECIFICATIONS

Following are some of the essential requirements of good specification writing.

**1. Subject matter**

The subject matter of specifications should relate to the information required after the contract is given to a particular contractor. The requirements which are to be enforced should only be included in the specifications.

**2. Grammar**

All sentences of the specifications should comply with the rules of grammar. The style and tense should remain the same throughout.

**3. Selection of words**

While writing specifications, only suitable words with desired meaning should be used. Unfamiliar words of works having more than one meaning should never be used in the specifications.

**4. Accuracy**

The information given in the specifications should be complete and correct, otherwise the contractor may claim for any extra cost due to damage occurred to him by the misleading information supplied by the specifications.

**5. Practical limits and commercial sizes**

The specifications should be framed keeping in view the practical limitations of materials and workmanship and they should not specify practical impossibilities. Also, the specifications should specify use of commercial sizes and patterns of the material.

**6. Fairness**

The specifications should be fair and they should not be framed in such a way as to throw all the risks on the shoulders of the contractor.

**7. Brevity**

The sentences of the specifications should be short, simple and concise. This is essential as the main purpose of the specifications is to give directions to the contractor and the supervising staff in carrying out the construction work.

## POINTS TO BE INCLUDED IN THE SPECIFICATIONS

The specifications shall contain the following points.

i. Quality of materials to be used with strength/size requirements,

ii. Quantity of materials to be used and the methods of measurements to be followed.

iii. Method of mixing when different materials are used.

iv. Construction methods to be followed mentioning the equipment and machinery to be used.

v. Dimensions of works such as breadth, thickness etc.,

vi. Methods of measurements of works for payments.

## GENERAL SPECIFICATION FOR FIRST CLASS BUILDING

### i. Foundation and plinth

Foundation and plinth shall be first class brick work in lime mortar or 1:6 cement mortar over lime concrete or 1:4:8 cement concrete.

### ii. Filling

Foundation trenches and plinth shall be filled with sand or local available earth.

### iii. Damp proof course

D.P.C shall be 2.5 cm(1") thick cement concrete 1:1 ½ :3 mixed with one kg of Impermo per bag of cement or other standard water proofing materials as specified and painted with two coat of bitumen.

### iv. Superstructure

Superstructure shall be of first class brick work lime mortar or 1:6 cement mortar. Lintels over doors and windows shall be of R.C.C.

### v. Roofing

Roof shall be of R.C.C. slab with an insulation layer and lime concrete terracing above, supported over R.S.Joist or R.C.C. beam as required. Height of rooms shall not be less than 3.7m (12 feet).

### vi. Flooring

Drawing room and dining room floors shall be mosaic (terrazzo). Bathroom and W.C. floor and dado shall be of mosaic (terrazzo). Floors of bedroom shall be coloured and polished of 2.5cm (1") cement concrete over 7.5cm (3") lime concrete. Floors of other shall be of 2.5cm (1") cement concrete over 7.5cm (3") lime concrete polished.

### vii. Finishing

Inside and outside wall shall be of 12mm (1/2") cement lime plastered 1:1:6. Drawing, dining, and bedrooms-inside shall distempered, and others-inside white washed 3 coasts. Outside shall be coloured snowcem washed two coats over one of white wash.

**viii. Doors and windows**

Chaukhats shall be seasoned teak wood. Shuttering shall be teak wood 4.3cm (1 ¾") thick panelled and partly glazed as required, with additional wire gauge shutter. All fitting shall be of brass. Doors and windows shall be varnished or painted two coats with high class enamel paints over one coat of priming. Windows shall be provided with iron grating or grills.

**ix. Miscellaneous**

Rain water pipes of cast iron or of asbestos cement shall be provided and finished painted. Building shall be provided with 1st class Sanitary and Water fittings and Electrical installations. 1 meter wide 7.5cm thick C.C. 1:3:3 apron shall be provided all round the building.

## GENERAL SPECIFICATION OF A SECOND CLASS BUILDING:

1. **Foundation and Plinth: -** Foundation and plinth shall be of first class brick work lime mortar over lime concrete.
2. **Damp Proof Course: -** D.P.C. shall be 2 cm thick cement concrete 1 : 2, mixed with one kg of impermo per bag of cement or other standard water proofing materials.
3. **Superstructure: -** Superstructure shall be of 2nd class brickwork in lime mortar. Lintels over doors and windows shall be of R.B.
4. **Roofing: -** Roofs shall be of R.B slab with an 7.5 cm lime concrete terracing above( or flat terraced roof supported over wooden battens and beams, or jack arch roof),verandah roof shall be of A.C sheet or allahabad tiles. floor shall be of brick tile or flag stone over lime concrete, finished cement pointed.
5. **Flooring: -** Floors shall be of 2.5 cm cement concrete over 7.5 cm lime concrete. Verandah floor shall be of brick tile or flag stone over lime concrete, finished cement pointed.
6. **Finishing: -** Inside and outside shall be of 12 mm cement mortar plastered 1 : 6 ceiling shall be cement plastered 1 : 3. Inside shall be white washed 3 coats, outside shall be coloured washed two coats over one coat of white wash.

7. **Door and Windows: -** Chaukhats shall be R.C.C or well-seasoned Sal wood. shutters shall be shisham wood or deodar wood 4 cm thick, paneled, glazed or partly paneled and partly glazed as required, fitted with iron fittings. Doors and windows shall be painted two coats over one coat of priming.
8. **For Other materials: -** Rain water pipes shall be of cast iron finished painted. Electrification, sanitary and water fittings may be provided if required.

## GENERAL SPECIFICATION OF A THIRD CLASS BUILDING:

1. **Foundation and Plinth :-** Foundation and plinth shall be of 2nd class brick work lime mortar over lime concrete.
2. **Dam Proof Course :-** D.P.C. shall be 2 cm thick cement mortar 1 : 2, mixed with standard water proofing materials.
3. **Superstructure :-** Superstructure shall be of 2nd class brickwork in mud mortar. Door and Windows opening shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks.
4. **Roofing :-** Roofs shall be of mud over tiles or bricks or planks over wooden beams or of tiles or G.I sheets sloping roof.
5. **Flooring :-** Floors shall be of brick on edge floor over well rammed earth.
6. **Finishing :-** Inside and outside shall be plastered with lime mortar and white washed three coats.
7. **Door and Windows :-** Chaukhats shall be of sal wood. shutters shall be chir mango or other country wood. Doors and windows shall be painted two coats with ordinary paint over one coat of priming.

## GENERAL SPECIFICATION OF FOURTH CLASS BUILDING:

1. **Foundation and Superstructure :-** Foundation and superstructure shall be of sun dried or kutcha bricks in mud mortar. door and windows openings shall be provided with arches of 2nd class brickwork in lime mortar or with wooden planks. inside and outside shall be water proof mud plastered.

2. **Roofing :-** Roofs shall be of tiles roof over bamboo and wooden support.
3. **Flooring :-** Floors shall be kutcha or earthen floor finished with gobri washing (cowdung lepping).
4. **Door and Windows :-** Chaukhats shall be of chir or mango wood, or country wood.

## GENERAL SPECIFICATIONS OF SOME WORKS INVOLVED IN THE CONSTRUCTION OF A RESIDENTIAL BUILDING

**i. Foundation Concrete:**

Cement concrete 1:4:8 using 40 mm size blue granite broken stone.

**ii. Foundation and Basement:**

Brickwork in cement mortar 1:5 using 7.5 grade bricks.

**iii. Super Structure:**

Brickwork in cement mortar 1:6 using 7.5 grade bricks.

**iv. Flooring:**

Mosaic flooring over a base of 100 mm thick cement concrete 1:5:10 using 40 mm size brick bats.

**v. Roofing:**

120 mm thick R.C.C. roof in 1:2:4 concrete using 20 mm size blur granite broken stone.

**vi. Finishing:**

Plastering the walls and ceilings with cement mortar 1:3, 12 mm thick and finishing the same with three coats of white washing.

**vii. Doors and Windows:**

Country wood doors and windows painted two coats with ready mixed paint over a primer coat.

## GENERAL SPECIFICATIONS OF FEW ITEMS OF WORKS INVOLVED IN THE LAYING OF A VILLAGE ROAD

**i. Sub grade:**

Leveling and compacting the surface with a camber of 1:48 for 8 metre width, uniform along the full length, with watering.

**ii. Soling:**

Soling with 150 mm size granite boulders, packed completely with gravel and compacted with hand roller, dry and wet rolling.

**iii. Spreading gravel:**

Red gravel spread over the base for 20 mm thickness, watered and rolled.

**iv. Finish:**

Covered with a thin layer of sand.

## EXAMPLES OF DETAILED SPECIFICATIONS OF MATERIALS

**1. Detailed Specification for sand for mortar**

The Sand used for mortar shall be clean, sharp, heavy and gritty. It should be free from clay, salt, mica and organic impurities. It shall not contain harmful chemicals in any form. Medium and fine sand are to be used in mortars. Coarse sand shall be sifted through 600 micron sieve and used in mortars for plastering works.

**2. Detailed Specification for first class bricks:**

The earth used for molding the bricks shall be free from organic matters salts and chemicals. The size, weight and colour of the burnt bricks should be uniform. The adjacent faces of the bricks are to be right angles to each other. The bricks shall be free from cracks, flaws and lumps. They should not break where dropped, from 1 metre height, on the ground. They should not absorb water by

more 15 % of their self-weight when immersed in water for one hour. The average compressive strength of the bricks shall be not less than 7.5 N/mm$^2$. The dry weight of one brick shall not be less than 3 kg.

## PROPERTIES OF FIRST CLASS BRICKS

- All bricks should be of first class of standard specifications.
- Bricks should be made of good earth completely burnt.
- Bricks should be of deep cherry red or copper color.
- Bricks should be regular in shape.
- Edges of bricks should be sharp.
- On being struck, bricks should emit clear ringing sound.
- Bricks should be free from cracks, chips, flaws and lumps of any kind.
- Bricks should not absorb water more than one sixth of its weight after one hour of immersing in water.
- Bricks should have a minimum crushing strength of 105 kg per square meter ( 1500 lbs per square inch).
- Bricks should be of standard dimensions as per I.S.I (19 cm x 9 cm x 9 cm)

**3. Detailed Specification for cement:**

Ordinary Portland cement or rapid hardening Portland cement confirming to IS: 269 – 1989 and IS:8041 – 1990 shall be used. The initial setting time of the cement shall not be less than 30 minutes and the final setting time shall not be greater than 10 hours. The average compressive strength, after 7 days curing, of 1:3 cement mortar cubes shall be not less than 33 N/mm$^2$ (33 grade).

**4. Detailed Specification for wood for doors and windows:**

The wood shall be teak, well-seasoned and dry. It should be free from cracks, knots, defects and disease. It should be sawn in the direction of grains so that the edges are perfectly straight and square. The dimensions of the frames/scantlings/planks shall be as prescribed in the drawings. Patching or plugging of any kind is not permitted.

**5. Detailed Specification for water for concrete:**

Water used for mixing and curing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water may be used for mixing concrete. The suspended organic solid matter in the water shall not exceed 200 mg/l and inorganic solid matter shall not exceed 3000 kg/l, the pH value of water shall be not less than 6. Water sued for curing should not produce any objectionable stain or unsightly deposit on the concrete surface. The presence of tannic acid or iron compounds in the water is objectionable.

**6. Detailed Specification for coarse aggregate:**

The aggregate to be used in reinforced cement concrete shall be of blue granite stone, machine crushed and well graded with a nominal size of 20 mm. It shall be hard, dense, durable strong and free from flakes. The aggregate shall not contain harmful materials such as coal, mica clay, shells, organic impurities etc. The compressive strength, crushing value etc of the aggregate shall be in accordance with the requirements of IS:383 – 1970.

**7. Detailed Specification for reinforcement:**

The reinforcement shall be of high strength deformed steel bars confirming to IS:1786 – 1985. It should be bendable, weldable and have the modulus of elasticity not less than 200 kN/mm$^2$. The yield strength of the steel used shall not be less than 415 N/mm$^2$. All reinforcement bars shall be free from loose mill scales, loose rust and coats of paints, oil, mud or other coatings which may destroy or reduce bond.

## DETAILED SPECIFICATION FOR EARTHWORK EXCAVATION

**Leveling the surface**

The whole area of construction is to be cleared of tees, grass, roots of trees etc., complete and leveled horizontally to enable easy marking of centre line of the building.

**Dimensions**

The excavation shall be done in accordance with dimensions of trenches shown in the working drawings.

**Shoring**

The sides of the trenches should be vertical and the bottom of the trenches should be flat. In the case of loose soils the sides of the trenches should be shored with steel sheets.

**Fencing**

Suitable temporary fencing is to be provided around the site of excavation to avoid any accidental fall into the trenches.

**Dumping the soil**

The excavated soil is to be dumped and heaped at a minimum distance of 1.5 meter away from the trenches so that it does not slide again into the trenches.

**Treatment at the bottom**

The bottom of the trench shall be watered and compacted by ramming before the foundation concrete is laid. Excessive excavations should not be adjusted by filling with loose excavated soils. Sand or plain concrete may be used for the adjustment of levels, that too with proper compaction.

## DETAILED SPECIFICATION FOR PLAIN CEMENT CONCRETE

**GENERAL SPECIFICATION**

- In plain cement concrete coarse aggregate should be hard durable and free from impurities.
- Fine aggregate should contain sharp, angular grain.
- Cement should be fresh Portland cement.
- Mixing should be done by hand mixing or by machine mixing.
- Laying and compaction should be done before setting of concrete i.e. within 30 min.
- Curing should be done for minimum 14 days.

## MATERIALS

### Coarse aggregate:

- Aggregates shall comply with the requirements of IS 383.
- It shall be crushed or broken from hard stone from the approved quarry.
- It shall be hard, strong, dense and durable, clean and free from soft friable, thin, flat, elongated or laminated, flaky pieces and shall be roughly cubical in shape.
- It shall be clean and free from dirt and any other foreign matter.
- Coarse aggregate may be graveled, may either be river bed shingle or pit graveled. It shall be sound, hard, clean suitably graded in size.
- This shall be free from flat particles of shale, powdered clay, slate, loam and other impurities.
- Gravel shall have to be washed if it contains soil materials adhering to it.
- Unless specially mentioned the size of the coarse aggregate shall be 20 mm graded down and shall be retained in 5mm square mesh so that the voids do not exceed 42%.

### Fine aggregate:

- Aggregate most of which passes 4.75mm IS sieve is known as fine aggregate. Sand as fine aggregate shall be coarse, consisting of sharp, angular grains and be of standard specification.
- Crushed dust stone may also be used as fine aggregate.

### Cement:

- Cements shall be phrased as Portland cement and confirmed to the ISI specification.
- It should have required compressive and tensile strength and fineness.

### Water:

- Water used shall be clean and reasonably free from injurious quantities of deleterious materials such as oils, acids, alkalis, salts and vegetable growth.

- Generally potable water shall be used.
- The pH value of the water should not be less than 6.
- The maximum permissible limits for solids shall be as per IS 456:2000 Clause 5.4, Page No 15.

**PROPORTION**

- Proportioning of cement, sand and coarse aggregate shall be 1:2:4 or as specified.
- Coarse aggregate and sand shall be measured by measuring box of 30cmx30cmx38cm of suitable size equivalent to one bag cement of 1/30 $m^3$or 0.035 $m^3$.
- Cement shall be measured by bag weighing 50kg.
- Sand shall be measured on the basis of its dry volume.
- While measuring the aggregate sacking, ramming or hammering shall not be done.
- If damp sand is used compensation shall be made by adding additional sand to the extent required for the bulking of damp sand.

**MIXING**

**Hand mixing:**

- Hand mixing by batches shall be permitted on small works.
- The mixing shall be done on a clean water tight masonry or concrete slab or steel plate platform.
- Measured quantity of sand shall be sprayed evenly. The cement shall be dumped on the sand and distributed evenly. The sand and cement shall be mixed thoroughly with spade turning the mixture over and over again until its even colour throughout and free from streaks. The measured

quantity of coarse aggregate shall be sprayed out and the sand cement mixture shall be sprayed on its top.

- This shall be mixed at least three times by shoveling and turning over by twist from centre to side then back to the centre and again to the sides.
- A hollow shall be made in the middle of the mixed pile.
- Three quarters of the total quantity of water required shall be added while the material is turned in toward the centre with spades.
- The remaining water shall be added by water can fitted with rose head slowly turning the whole mixtures over and over until a uniform colour and consistency is obtained throughout the pile.

**Machine Mixing:**

- Measured quantity of dry coarse aggregate, fine aggregate and cement shall be placed in the hopper respectively.
- The dry materials shall be mixed in the mixing drum for at least four turns of the drum after which correct quantity of water shall be added gradually while the drum is in motion.
- The total quantity of water for the mixing shall be introduced before 25% of the mixing time has elapsed and shall be regulated to achieve the specific water cement ratio.
- The mixing shall be thorough to have a plastic mix of uniform colour.

**MIXING TIME:**

- The materials shall be mixed in a drum for a period of not less than 2 min and until a uniform colour and consistency obtained.
- The time shall be counted from the moment all the materials have been put into the drum.

## CONSISTENCY

- The quantity of water to be used for each mix of 50kg cement to give the required consistency shall be as follows

Not more than 34 lit – 1:3:6 mix

Not more than 30lit – 1:2:4 mix

Not more than 27lit – 1:1 ½:3 mix

Not more than 25lit – 1:1:2 mix

- The quantity of water shall be regulated by carrying out regular slump test.

## LAYING

- The entire concrete used in the work shall be laid gently in layers not exceeding 15cm and shall be thoroughly vibrated by means of mechanical vibrators till a dense concrete is obtained.
- Hand compaction shall be done with the help of punning rods and tamping rods and tamping with the wooden tampers so that concrete is thoroughly compacted and completely walked into the corners of the form work.
- The layers of concrete shall be so placed that the bottom layer does not finally sit before the top layer is placed.
- Compaction shall be completed before the initial setting starts that is within thirty minutes of addition of water to the dry mixture.

## PROTECTION AND CURING

- Freshly laid concrete shall be protected from rain by suitable covering
- After the concrete as begun to harden, that is about one to two hours after its laying it shall be protected with moist gunny bags, sand or any other materials against quick drying.
- After 24hrs of lying of concrete the surface shall be cured by flooding with water of about 25mm depth or by covering with weight absorbent materials .Curing shall be done for a minimum period of 14 days.

**FORMWORK**

- If centering and shuttering are required to be done for this work.
- This shall be done in accordance with the specifications for form work under R.C.C

## DETAILED SPECIFICATION FOR REINFORCED CEMENT CONCRETE

### a) Materials

Ordinary Portland cement or rapid hardening Portland cement confirming to IS: 269 – 1989 and IS:8041 – 1990 shall be used. The fineness of the cement shall not be less than 30 minutes and the final setting time shall not be greater than 10 hours. The average compressive strength, after 7 days curing, of 1:3 cement mortar cubes shall be not less than 33 $N/mm^2$ (33 grade).

The sand used for mortar shall be clean, sharp, heavy and gritty. It should be free from clay, salt, mica and organic impurities. It shall not contain harmful chemicals in any form. Medium and fine sand are to be used in mortars. Coarse sand shall be sieved through 600 micron sieve and used in mortars for plastering works. Reinforcement shall be hooked and bent (cold) and placed in position as per design and drawing and bound together tight with 20 S.W.G binding steel wire.

### b) Centering and shuttering

Centering and shuttering shall be made of timber and tight with necessary wedges and sufficiently strong and sable not to yield under laying of concrete. A coat of oil washing or a thin layer of paper shall be spread to have a smooth finished surface preventing adherence of concrete.

### c) Proportioning

Proportions of cement, sand and course aggregate shall be 1:2:4 for slab, beam and lintels and 1:1.5:3 for columns unless otherwise specified. The sand and course aggregate shall be measured by volume with boxed and cement by number of bags.

**d) Mixing of concrete**

Concrete shall be mixed by concrete mixture. Cement, sand and course aggregate shall be put into the as per the required proportions for one batch. The total quantity shall not exceed the manufactures rated capacity. The machine shall be revolved to mix materials dry and then water shall be added up to the required quantity. After 2 minutes rotation for through mixing, the mixed concrete shall be discharged on a masonry platform or iron sheet.

**e) Laying of concrete**

Concrete shall be laid gently in layers not exceeding 150 mm and compacted by wooden thapi or some mechanical vibrator until a dense concrete is obtained. While concreting, steel bars shall be given side band bottom covers of concrete by pacing the precast concrete blocks of 1:2 cement mortar 25x25 mm in section and thickness of specified cover. Concreting shall be laid continuously. If laying is suspended for rest or the following day, the end shall be slopped at an angle of 300 and made rough for future jointing. When the work is resumed, the previous slopped surface shall be roughened, cleaned and a coat of neat cement paste shall be applied and then the fresh concrete shall be laid.

**f) Curing of concrete**

Freshly laid concrete shall be protected from rain by suitable covering. After 24 hrs of laying of concrete the surface shall be cured by flowing with water of above 25 mm depth or with covering by wet gunny bags. The curing shall be for a minimum period of 14 days or otherwise specified.

**g) Removal of form work**

The centering and shuttering shall be removed after 14 days of casting. It shall be removed slowly and carefully so that no part is disturbed.

**h) Measurement**

The measurement shall be taken in cu. m. The rate shall be for the complete work inclusive of form work and all tools and plants but excluding steel.

## SPECIFICATIONS OF FIRST CLASS BRICKWORK

- All of the bricks used should be of first class.
- See the characteristics of first class bricks .
- Soaking of bricks should be done by submerging in a tank before use.

- Soaking should be continue until the air bubbles are ceased.
- Soaking should be for a period of 12 hour before use.

**Mortar specifications for first class brickwork**

- Material of mortar should be of standard specifications.
- For mortar, cement should be fresh ordinary Portland cement of standard specifications.
- Sand should be sharp and free from organic and foreign particles.
- If we want to make rich mortar, sand should be coarse or medium.
- For weak mortar, local fine sand may be used.
- Cement sand ratio of mortar should be 1:3 to 1:6 as specified.
- To get the required proportion, materials of mortar should be measured with the measuring box.
- Materials of mortar should be first mixed dry to have a uniform color.
- The platform should be clean for mortar mixing.
- Mixing should be done at least three times.
- Then water should be added gradually for workable consistency.
- Mortar should be freshly mixed.
- Old mortar should not be used.
- Mortar should be mixed with water for one hour work so that mortar may be used before setting.

**Lime Surkhi mortar**

- If specified lime surkhi mortar, should be mixed in 1:2 to 1:3 ratio as specified, by grinding in mortar mill for at least three hours to use on the same day.
- Lime should be fresh and should be screened.
- Fresh mixed mortar should be used.
- For small work, hand mixing may be allowed just as in the case of cement sand mortar.

## LAYING OF FIRST CLASS BRICKWORK

- Bricks should be laid in English bond unless otherwise specified.
- Every course of brick should be horizontal.
- Wall should be truly in plumb.
- Vertical joints of consecutive brick layer should not come on each other.
- Vertical joints of alternate brick layer should come directly over one another.
- Closers should be of clean cut bricks.
- Closers should be placed at the end of the walls but not at the other edge.
- Best shaped brick should be used for face work.
- Mortar joints should not exceed 6 mm or 0.5 inch in thickness.
- Joints should be fully filled with mortar.
- Bricks should be laid with frogs upwards except in the top brick layer.
- In the top course of brickwork, frog should be laid downward.
- Brickwork should be done for 1 meter or 3 feet height at a time.
- When one part of the wall has to be delayed then stepping should be done at an angle of 45 degree.
- Projections where made should not be more than 1/4th of the brick in one course.
- All joints should be raked and faces of wall should be cleaned at the end of every day"s work.

## Curing of First class brickwork

- Brickwork should be kept wet for the period of at least 10 days.
- Top of the walls should be flooded with water at the end of the days work by making small weak mortar edging to contain at least 2.5 cm or 1 inch deep water.

## Other considerations for first class brickwork

- Brickwork should be protected from the effect of sun, rain, frost etc., during the construction.
- Suitable Scaffolding should be provided to facilitate the construction of brickwork.
- Scaffolding should be strong enough to withstand all the expected loads to come upon them.

## Measurement of First class brickwork

- Brickwork should be measured in cubic meter or cubic feet.
- Different kinds of brickwork with different mortar should be taken under separate item.
- Thickness of wall should be taken as multiple of half brick.
- For example half brick wall thickness is taken as 10 cm or 4.5 inch.
- Full brick wall thickness is taken as 9 inches or 20 cm and so on.
- Rate should be for the complete work including scaffolding and all tools and plants used.

## DETAILED SPECIFICATION OF DAMP PROOF COURSE

Dampness in Buildings Protect building and people from harmful effects caused by

- Ground moisture
- Rain
- Interstitial and surface condensation
- Spillage of water from sanitary objects

**What is Dampness?**

Damp is generally defined as unwanted water or moisture. The existence of dampness in buildings is one of the most damaging failures that can occur in buildings. It can cause

- Damage in brickwork by saturating it
- Decay and breaking up of mortar joints
- Dry and wet rot in timber structures
- Corrosion of iron and steel Physical Effects
- Freeze/thaw
- Timber rot
- Water staining
- Cyclic wetting/drying
- Insulation values reduced
- Electrics made unsafe Chemical effects Efflorescence Crypto florescence Corrosion of ferrous metals Chemical attack (e.g. sulphate) Cohesion loss Effects on Health
- Ambient air conditions
- Mould growth & spores
- Viruses & infections
- Rot & infestation
- Psychological Rising Damp

The majority of construction materials are porous. This means they will soak up a considerable amount of water. Rising Damp Rising damp is caused by a natural phenomenon called „capillary action" wherein ground water is drawn vertically upwards through fine pores in a material.

Construction materials are either embedded in, or in contact with the ground which will encourage the migration of water from the ground by capillary action. Furthermore, osmosis encourages the movement of water relative to the concentration of salts.

## DETAILED SPECIFICATION FOR DAMP PROOF COURSE (D.P.C.)

### a) Materials

Damp Poof Course shall be of plain cement concrete of 1:2:4 mix and 30 mm thickness. 12 mm size hard and dense stone chips shall be used as coarse aggregate and river sand of 5 mm nominal size shall be used as fine aggregate. The aggregate shall be clean and free from dust, dirt, mud, organic matter etc. The coarse aggregate is to be washed well before mixing. Fresh port land cement of I.S.I. approved brand of 43 grades is to be used as the binding material. Potable water, free from harmful salts, shall be only used for mixing the concrete.

### b) Preparation of mortar

The coarse aggregate and sand are to be measured separately by volume and mixed dry in a clean and stable platform to get a mixture of uniform colour. This mixture is stacked to a uniform height and the cement of required quantity is spread over the stack, turned over in dry state first, and with water twice to get a workable and uniform concrete.

### c) Application of DPC

The brickwork in basement is stopped at plinth level, cured will for 7 days, top surface cleaned well for dust by wire brushes. Form work is provided along the two sides of wall by wooden planks, to the required height. Gauge plates are to be provided at one meter interval, connecting the two side planks by nails, keeping at a clear distance equal to the width of wall at plinth level.

The concrete, mixed as mentioned above, shall be placed and compacted well by tamping rods to have a net thickness of 30 mm. Damp proof course shall not have any joints, the whole concreting be completed without any break, and it need not be provided over door openings. The top surface of concrete, when starts to dry, shall be roughened to provide bondage with the super

structure. The side planks shall be removed on the next day and the concrete shall be cured for 7 days by keeping the surface constantly wet.

**d) Measurement**

The concrete, mixed as mentioned above, shall be placed and compacted well by tamping rods to have a net thickness of 30 mm

## DETAILED SPECIFICATION OF PLASTERING WITH CEMENT

**a) Materials**

Ordinary Portland cement or rapid hardening Portland cement confirming to IS: 269 – 1989 and IS:8041 – 1990 shall be used. The fineness of the cement shall not be less than 30 minutes and the final setting time shall not be greater than 10 hours. The average compressive strength, after 7 days curing, of 1:3 cement mortar cubes shall be not less than 33 N/mm2 (33 grade).

The sand used for mortar shall be clean, sharp, heavy and gritty. It should be free from clay, salt, mica and organic impurities. It shall not contain harmful chemicals in any form. Medium and fine sand are to be used in mortars. Coarse sand shall be sieved through 600 micron sieve and used in mortars for plastering works.

**b) Preparation of mortar**

The materials (cement and sand), with ratio 1:4 for inner wall and 1:6 for outer wall, shall be first mixed dry thoroughly till uniform colour is obtained and then shall be mixed wet adding water slowly and gradually for at least turning three times to give uniform consistency.

**c) Preparation of surface**

The joints of brick work shall be racked out a depth of 18 mm and the surface shall be brushed, cleaned, watered and kept wet for two days before plastering. In case of cement concrete surface, the face shall lightly roughen, cleaned, washed and wetted.

**d) Application of mortar**

Plastering shall be started from the top and proceed towards the bottom. The plastered surface shall be made level and flush with wooden straight edges and rubbed thoroughly with wooden floats to ensure smooth and even surface.

**e) Curing**

The work shall be kept well watered for at least 15 days.

**f) Measurement**

The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

## DETAILED SPECIFICATION FOR MOSAIC TILE FLOORING

**a) Base Course**

The basic course shall be of 25 mm thick cement concrete of a 1:2:4 mix using 12 mm size granite stone chips as coarse aggregate and sand as fine aggregate. The top of flooring concrete or R.C.C. slab shall be cleaned well and applied with cement slurry of 2 kg/m2 before placing the chips concrete. The base course is to be compacted, leveled and smoothed by wooden floats.

**b) Mosaic Tiles**

Precast tiles of 200 mm x 200 mm x 20 mm size are to be used. They shall be manufactured under hydraulic pressure of not less than 14 N/mm2 and given the first grinding with machine before laying. The proportion of cement to sand in the backing of the tiles shall not be leaner than 1:3 by weight. Similarly the proportion of cement to marble power to marble chips in the wearing layer of the tiles shall be not leaner than 3:1:7. The marble chips shall be hard, dense sound and homogeneous in texture.

**c) Laying of Tiles**

The bedding for the tiles shall be with cement mortar 1:3. The average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall be not less than 10 mm. Cement bedding shall be spread, tamped and corrected to proper levels and allowed to harden before the tiles are set. Neat cement slurry of honey like consistency shall be spread over the bedding at the rate of 4.4 kg/m2. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till is properly bedded and in level

with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1.5 mm and in straight lines.

**d) Curing, Polishing and Finishing**

The day after the tiles are laid, all joints shall be cleared of the grey cement grout with a wire brush to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grounded with whit e cement mixed with pigment to match the shade of tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat. The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with the polishing machine fitted with coarse grade grit blocks, adding required water during the process. After grinding, the surface shall be washed clean and covered with thin coat of cement slurry with pigment. The surface shall be again cured and polished with machine fitted with medium grade grit blocks. Similarly a third grinding shall be done by fine grade grit blocks. After the final polish, the surface shall be cleaned using diluted oxalic acid and wiped with a soft cloth. The measurement shall be taken in sq. m. The rate shall be for the complete work inclusive of all tools and plants.

## DETAILED SPECIFICATION FOR WOOD WORK FOR DOOR AND WINDOW FRAMES

**a) Materials**

Timber shall be of teak, sal, deodar etc., as mentioned, well-seasoned, dry, free from sap, knots, crack or any other defects or diseases. It shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The scantling shall be planned smooth and accurate to the full dimensions, rebates, rounding and mouldings as shown in the drawing made, before assembling. Patching or plugging of any kind shall not be permitted except as provided.

**b) Joints**

These shall be mortise and tenon type, simple, neat and strong. Mortise and tenon joints shall fit in fully and accurately without wedging or filling. The joints shall be glued framed, put together and pinned with hardwood or bamboo pins not

less than 10 mm dia. after frames are put together pressed in position by means of a press.

**c) Surface Treatment**

Wood work shall not be tainted, oiled or otherwise treated before it has been approved by the Engineer-in-Charge. All portions of timber abutting against masonry or concrete or embedded in ground shall be painted with approved wood primer or with boiling coal tar.

**d) Gluing of Joints**

The contract surface of tenon and mortise joints shall be treated before putting together with bulk type synthetic resin adhesive of a make approved by the Engineer in-Charge.

**e) Fixing in position**

The frame shall be placed in position truly vertical before the masonry reaches half the highest of the opening with iron clamps or as directed by the Engineer-in-Charge. In case of door frames without sills, the vertical members shall be embedded in the flooring to a depth of 40 mm or as directed by the Engineer-in-Charge. The door frames without sills while being placed in position shall be suitably strutted and wedged in order to prevent warping during construction. The frames shall also be protected from damage, during construction.

## DETAILED SPECIFICATION FOR WOOD WORK FOR DOOR AND WINDOW SHUTTERS

**a) Materials**

Specified timber shall be used, and it shall be well seasoned, dry, free from sap, knots crack or any other defects or disease. Patching or plugging of any kind shall not be permitted except as provided.

**b) Joinery work:**

All pieces shall be accurately cut and planned smooth to the full dimension. All members of the shutters shall be straight without any warp or bow and shall have smooth, well planned faces at right angles to each other. In case of panelled shutters the corners and edges of panels shall be finished as shown in drawings, and these shall be feather tongued into styles and rails. The panels shall

be framed into groovers to the full depth of the groove leaving an air space of 1.5 mm and the faces shall be closely fitted to the sides of the groove. In case of glazed shutter, sash bars shall have mitred joints with styles.

Styles and rails shall be properly and accurately mortised and tenoned. Rails which are more than 180 mm in width shall have two tenons. Styles and end rails of shutters shall be made out of one piece only. The tenons shall pass through styles for at least 1 th of the width of the style. When assembling a leaf, styles shall be left projecting as a horn. The styles and; rails shall have 12 mm groove in paneled portion for the panel to fit in.

The depth of rebate in frame for housing the shutters shall in all cases be 1.25 cm and the rebate in shutters for closing in double shutter doors or windows shall be not less than 2 cm. The rebate shall be splayed. The joints shall be presses and secured bybamboo pins of about 6 mm diameter. The horns of styles shall be sawn off.

**c) For battened shutters:**

Planks for batten shall be 20 mm thick unless otherwise specified and of uniform width of 125 to 175 mm. These shall be planned and made smooth, and provided with minimum 12 mm rebated joints. The joint lines shall be chamfered. Unless otherwise specified the battens for ledges and Braces shall be 30 mm thick and fixed with the battens on the inside face of shutter with minimum two number 50 mm long wood screws per batten. The ledges shall be 225 mm wide and braces 175 mm wide, unless otherwise specified. The braces shall incline downwards towards the side on which the door is being hung.

**d) Gluing of joints for paneled or Glazed shutters :**

The contact surfaces of tenon and mortise joints shall be treated before putting together with bulk type synthetic resin adhesive of a make approved by the Engineer in-Charge. Shutters shall not be painted, oiled or otherwise treated, before these are fixed in position and passed by the Engineer-in-Charge. For glazed shutters, mounting and glazing bars shall be tub-tenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm, whichever is less.

**e) Fittings:**

Details of fittings to be provided shall be as per the schedule of fittings supplied by the Engineer-in-Charge in each case. The cost of providing and fixing shutters shall include the cost of hinges and necessary screws for fixing the same. All

other fittings shall be enumerated and paid for separately. The fittings shall conform to their respective IS specifications. Where fittings are stipulated to be supplied by the department free of cost, screws for fixing the fittings shall be provided by the contractor and nothing extra will be paid for the same.

## DETAILED SPECIFICATION FOR PAINTING NEW WOOD WORK

**a) Paint**

Ready mixed paint of approved quality and colour shall be used

**b) Preparation of surface**

The surface to be painted shall be rubbed down smooth with medium and fine sand papers and cleaned off any dust. Knots, cracks holes etc., shall be filled with putty made of 2 parts of whiting. 1 part of white lead mixed together in linseed oil and leveled to the surface. A primer coat is applied to the surface with ready mixed wood primer of best quality.

**c) Application**

Painting shall be carried out at the driest season of the year. Paint shall be applied with brushes, smoothly spread without any visible brush mark. The second coat shall be applied when the first coat is perfectly dried. The paint shall be stirred often with stick so that it does not settle down.

## PREPARATION OF SURFACE AND LAYING OF TILES FOR FLOORING

**1. Preparation of Surface:**

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:6 (1 cement : 6 sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper slope and levels. Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread @ 3.3 kg of cement/sqm. over an area upto one square metre and combed using suitable combing trowel, to receive tiles.

Tiles shall be soaked in water, washed clean and shall be fixed on the prepared mortar bed one after another following the arrow mark on back of the tiles. Each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern, unless specified use of specific spacers. After tiles have been laid, surplus cement slurry shall be cleaned off.

The surface of the flooring during laying shall be frequently checked with a straight edge of about 2m long, so as to obtain a true surface with the required slope. In bath, toilet, W.C., kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing shall be given in addition to required slope to avoid spread of water. Where full size tiles cannot be fixed, these shall be cut/sawn to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

**2. Pointing and Finishing:**

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment as required to match the colour of tiles. Where tiles spacer lugs are provided, the half the depth of joint shall be filled with cement grout and the remaining top half of the joint shall be filled with approved tile grouting compound or as specified without the lugs remaining exposed. After necessary curing, the finished surface shall be washed and cleaned. The finished floor shall not sound hollow when tapped with a wooden mallet.

**3. Measurements:**

Length and breadth shall be measured correct to a cm between Skirting / Dado and the area calculated in square metre correct to two places of decimal. No deduction shall be made nor extra paid for voids/opening of areas less than 0.10 square metre.

**4. Rate:**

The rate for flooring shall include the cost of all materials and labour involved in all the operations described above unless otherwise specified in the item. Nothing extra shall be paid for cutting of the tiles to required size to suit the site condition and/or to complete the work as per the drawings.

## PREPARATION OF SURFACE AND CLADDING OF TILES FOR SKIRTING/DADO ETC.

### 1. Preparation of Surfaces:

The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before commencing the work.

### 2. Cladding:

12 mm thick plaster of cement mortar 1:4 (1 cement : 4 sand) mix or as specified shall be applied and roughened with wire brushes or by scratching diagonal at closed intervals. The tiles should be soaked in water, washed clean, and a coat of cement paste applied fully at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed.

The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd/cut size of tile shall be adjusted at bottom to take care of slope of the flooring. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed, these shall be cut/sawn to the required size and their edges rubbed smooth. Skirting/dado shall not project from the finished "surface of wall" by more than the tile thickness; undulations if any shall be adjusted in wall.

### 3. Finishing & Curing:

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 to 3 mm and all dust and loose mortar removed. Joints shall then be filled with white cement added with pigments as required to match the colour of tiles. After necessary curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

### 4. Measurements:

Length shall be measured correct to a cm. Height shall be measured correct to a cm in the case of dado and 5 mm in the case of riser and skirting. The area shall be calculated in square metre, correct to two places of decimal. Length and height shall be measured along the finished face of the skirting or dado

including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used, the area of dado shall be measured excluding the cornices. Nothing extra shall be paid for cutting of the tiles to required size to suit the site condition and/or to complete the work as per the drawings.

**5. Rates:**

The rate shall include the cost of all material, labour, cement mortar backing coat, part cutting of tiles, bevelling of tiles at corner joints (if specified in the item) and all the operations described above, unless otherwise specified. The specials such as designer borders, coves, internal and external angles and beading shall be measured and paid for separately.

# UNIT II

# ESTIMATION

## INTRODUCTION

Before taking up any work for its execution, the owner or builder should have a thorough knowledge about the volume of work that can be completed within the limits of his funds or the probable cost that may be required to complete the proposed work. It is therefore necessary to prepare the probable cost or estimate for the proposed work from its plan and specification. Besides the above, an estimate for any public construction work is required to be prepared and submitted beforehand so that sanction of necessary funds may be obtained from the authority concerned.

Thus an estimate for any construction work may be defined as the process of calculating the quantities and costs of the various items required in connection with the work. It is prepared by calculating the quantities from the dimensions on the drawings for the various items required to complete the project and multiplies by the unit cost of the item concerned. To prepare and estimate drawings consisting of the plan, the elevation and the sections through important points, along with a detailed specification giving specific description of all workmanship, properties and proportions of materials are required.

## PURPOSE OF ESTIMATION

Estimate for a work or project is necessary mainly for the following purposes: -

i) To ascertain the necessary amount of money required by the owner to complete the proposed work. For public construction works, estimates are required to obtain administrative approval, allotment of funds and technical sanction.

ii) To ascertain quantities of materials required in order to programme their timely procurement. To procure controlled materials, if any, like cement, steel, etc.; quantities of such materials are worked out from the estimate of the work and attached with the application for verification.

iii) To calculate the number of different categories of workers that are to be employed to complete the work within the schedule time of completion.

iv) To assess the requirements of tools, plants and equipment required to complete the work according to the programme.

v) To fix up the completion period from the volume of works involved in the estimate.

vi) To draw up a construction schedule and programme and also to arrange the funds required according to the programming.

vii) To justify the investment from benefits cost ratio.

viii) To invite tenders and prepare bills for payment.

ix) An estimate for an existing property is required for valuation.

## TYPES OF ESTIMATES

There are different types of estimates and they are as follows:

1. **Detailed estimate: -**

This includes the detailed particulars for the quantities, rates and costs of all the items involved for satisfactory completion of a project. Quantities of all items of work are calculated from their respective dimensions on the drawings on a measurement sheet. Multiplying these quantities by their respective rates in a separate sheet, the cost of all items of work are worked out individually and then summarised i.e., abstracted. All other expenses required for satisfactory completion of projects are added to the above cost to frame the total of a detailed estimate. This is the best and the most accurate estimate that can be prepared.

A detailed estimate is accompanied by
a) Report,
b) Specifications,
c) Detailed drawings showing plans, different sections, key or index plans etc.,
d) Design data and calculations, e) Basis of rates adopted in the estimate.

2. **Preliminary or approximate or rough estimate: -**

This is an approximate estimate to find out an approximate cost in a short time and thus enables the authority concerned to consider the financial aspect of the scheme, for according the sanction to the same. Such an estimate is framed after knowing the rate of similar works and from practical knowledge in various ways for various types of works such as: a) Plinth area or square metre method, b) Cubic rate or cubic metre method,

c) Service unit or unit rate method, d) Bay method, e) Approximate quantities with bill method, f) Cost comparison method,g) cost for materials and labour.

3. **Quantity estimate or quantity survey: -**

This is a complete estimate or list of quantities for all items of work required to complete the concerned project. The quantity of each individual item of work is worked out from respective dimensions on the drawing of the structure. To find the cost of an item its quantity is multiplied by the rate per unit for that item. The purpose is to provide a complete list of quantities necessary for the completion of any engineering project and when priced gives the estimate cost of the project.

4. **Revised estimate: -**

A revised estimate is a detailed estimate for the revised quantities and rates of items of works originally provided in the estimate without material deviations of a structural nature from the design originally approved for a project. It is accompanied with a comparative statement abstract from showing the probable variations for quantity, rate and amount for each item of work of the project as compared with the original estimate side by side stating the reasons for variation. A revised estimate is prepared and submitted for fresh technical sanction. It is required to be prepared for the following reasons.: -

a) When a sanctioned estimate is likely to exceed by more than 5% either from the rates being found insufficient or from any cause whatsoever except important structural alterations.

b) When the expenditure work exceeds or is likely to exceed by more than 10% of the administrative approval (for more than Rs. 5 lakhs).

c) When there are material deviations from the original proposal but not due to material deviation of a structural nature.

d) When it is found that sanctioned estimate is more than the actual requirement.

5. **Supplementary estimate**: -

While a work is in progress some changes or additional works due to material deviation of a structural nature from the design originally approved may be thought necessary for the development of a project. An estimate is then prepared to include all such works. This is known as

supplementary estimate. The method of preparation of supplementary estimate is the same as that of a detailed estimate and it should be accompanied by a full report of the circumstances which render its necessity.

**6. Combination of revised and supplementary estimate: -**

During execution of a project it may be necessary to revise the original estimate due to increased volume of original proposed work and at the same time sanction of supplementary works. For such a case a revised estimate is prepared for the increased volume of original work and a detailed estimate for the supplementary works not included in the original schedule. The amount of supplementary estimate is added to the revised estimate showing the amount separately.

**Difference between revised and supplementary estimate**

The main differences between the revised and supplementary estimates are shown below point wise side by side.

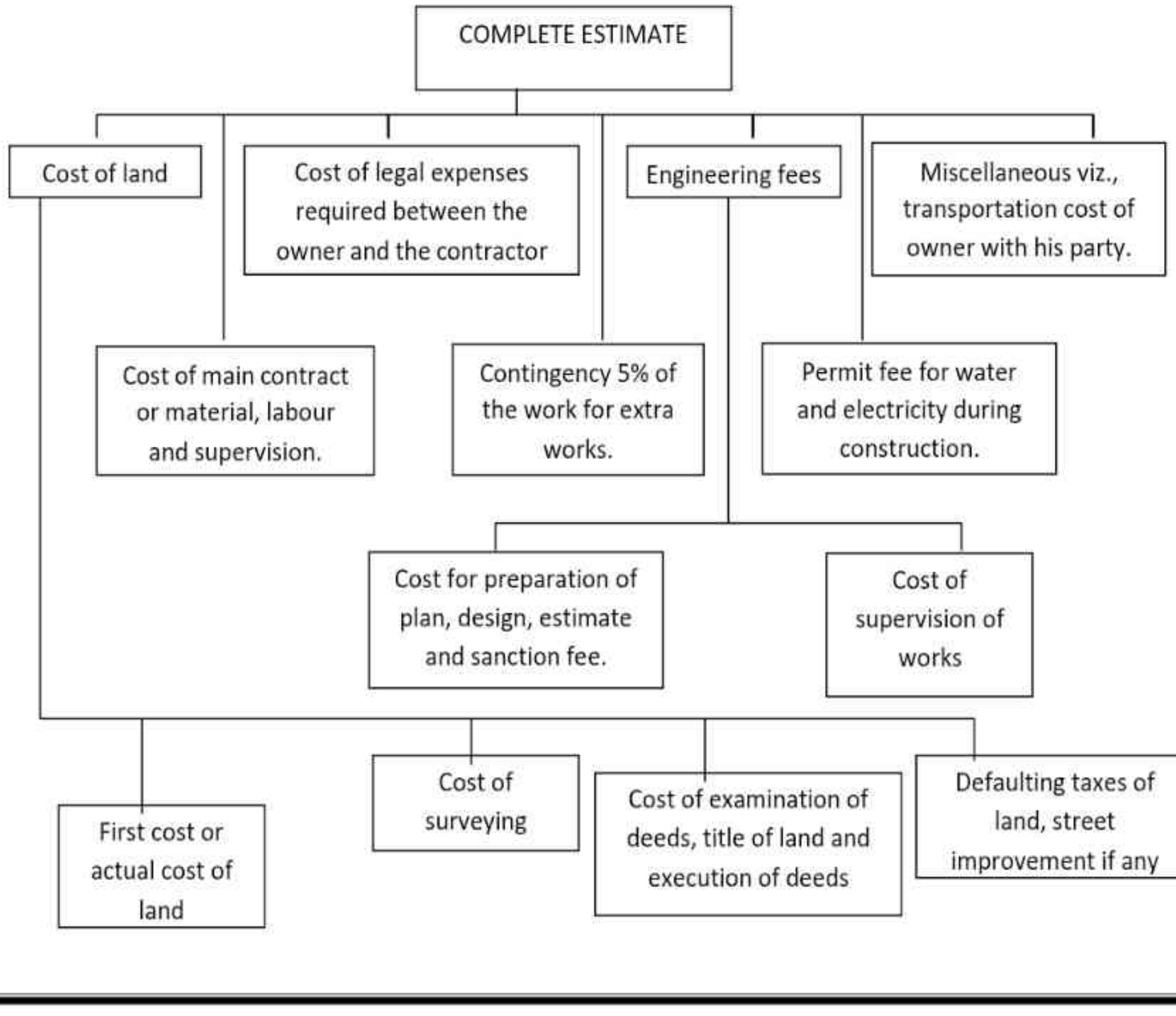
| REVISED ESTIMATE | SUPPLEMENTARY ESTIMATE |
|---|---|
| i) This is required when sanctioned amount is exceeded due to change of rates or addition of works fairly dependent on the work at first sanctioned. So, a revised estimate is due to material deviation from the original proposal. | i) This is required due to supplementary works which are fairly independent of the work at the first sanctioned. So supplementary estimate is due to material deviation of a structural nature from the deign originally approved. |
| ii) It is accompanied with a comparative statement abstract from showing the problem variations for quantity, rate and amount against each items of work involved in the project. | ii) No comparative abstract form is required. This is an estimate for additional works only. The abstract shows the original estimate and the total amount of the sanction required including supplementary amount. |
| iii) Revised estimate is required due to change of rate or quantity of materials, so no additions or revisions of drawings is necessary. | iii) Supplementary estimate is required due to some new works or due to change of design, so additions or revisions of drawings may be necessary. |

7. **Revised estimate and supplementary estimates due to reduction of cost (following P.W.D. manual): -**

In cases, where substantial section of a project costing not less than 5% of the total sanctioned cost of the project is abandoned or where material deviations from the original proposals are expected to result in substantial savings, the estimate is revised by the department and intimidated to the engineer-in-charge for the execution of work. But in cases where the saving is due to material deviation of a structural nature from the design originally approved supplementary estimate is prepared for a revised technical sanction.

8. **Complete estimate: -**

This is an estimated cost of all items which are related to the work in addition to the main contract or to the "detailed estimate". One may think than estimate of a structure includes only the cost of land and the cost of main contract or labours, materials and supervision. In addition, there are many other cost items to be included. A picture of a complete estimate is diagrammatically shown below.



**9. Annual maintenance or repair estimate (A.M. or A.R. estimate): -**

After completion of a work it is necessary to maintain the same for its proper function and for the same, as an estimate is prepared for the items which require renewal, replacement, repairs etc. in the form of an detailed estimate. The total estimated cost of maintenance of a structure is generally kept within the prescribed limits on percentage basis (variable according to the age and importance of the structure) of the cost of the construction of the structure and its importance.

**MEASUREMENT FORM**

| SL.NO | Description of particulars | No | Length | Breadth | Height or Depth | Content or Quantity |
|---|---|---|---|---|---|---|
| | | | | | | |

**ABSTRACT OF AN ESTIMATE**

| SL.NO | Description of particulars | Quantity | Unit | Rate Rs. P. | Unit of rate | Amount Rs. P. |
|---|---|---|---|---|---|---|
| | | | | | | |

The detailed estimate is generally accompanied by:-

i) Report

ii) Specifications

iii) Drawings consisting – plans, sections and elevations; site plan or layout; index plan.

iv) Design chart and calculations

v) Particulars of rate.

The main functions of an abstract estimate are:-

i) The total estimated cost and the different items of work required to complete a project can be known.

ii) This is the basis on which percentage rate tenders are called after excluding the amounts for contingencies and work-charged establishment.

iii) This is a part of attender document and a contractor can arrive at his own rates from the schedule of work description.

iv) This is the basis on which bills are prepared for payment.

v) Comparative costs of different items of work can be known.

## APPROXIMATE ESTIMATES OF ESTIMATING FOR BUILDINGS

Provisions for services like sanitary, water supply drainage and electric installations etc., should be made on the basis of percentage cost of the building estimate, as considered reasonable according to the specifications to be adopted.

The following are the common methods used to estimate buildings and are described one by one for appropriate application according to the classification of buildings.

### 1. Plinth area or square-metre method

To prepare an estimate by this method the plinth area of a building shall be determined first. But plinth area may also have to be worked out from floor area, or carpet area or covered area or rentable area of a building. So all the terms are described one by one. Similarly the circulation area should be known to calculate the plinth area.

**a) Plinth area: -**

The plinth area is the built up covered area measured at the floor level of the basement or of any storey of a building. Plinth area can be calculated by taking the external dimensions of the building excluding plinth offsets. Includes- floor area; stair cover; internal shaft for sanitary; lift well, machine room; area of porch other than cantilevered. Excludes- loft area; balcony; architectural feature; louvers and sun breakers projecting out; cantilevered porch; spiral staircase; open

platform; terrace, towers, turrets projecting above terrace level; additional floor for seating in theatre and auditoriums etc.

**b) Floor area: -**

The floor area is the plinth area less the area of the walls. It includes- doors and other openings; pillars; pilasters along the walls; flues within walls; fire place; built in cupboard, almirah and shelf.

**c) Carpet area: -**

The carpet area is the floor area less the area of the following portions- veranda; corridor and passage; entrance hall and porch; staircase and cover; bathroom and lavatory; useable area for living; kitchen and pantry; store; canteen; shaft and machine room for lift; AC duct and plant room; shaft for sanitary piping.

**d) Covered area: -**

The covered area is the ground area covered by the building immediately above the plinth level. Excluded- watchmen"s booth, pump house, garbage shaft, electric cabin; uncovered staircase, ramps, areas covered by chajja, compound wall, porch and portico; garden, rockery, well, plant nursery; drainage culvert, gutter etc.

**e) Rentable area: -**

For residential buildings the area shall be the carpet area along with carpet area of kitchen, pantry, store, lavatory, bathroom and 50% of carpet area of unglazed and 100% of glazed veranda. Excluded- storage space on top, landings, 50% of balconies.

**f) Circulation area or free space area: -**

A certain amount of free space area is required for movement and access to different room. Sitting room, kitchen, batch etc. for those who use the building which is known as circulation or free area. The circulation area may be

i) horizontal circulation area

ii) Vertical circulation area.

## 2. Cubic rate or cubic metre method

The method of estimating building cost by cubic metre volume is more accurate in general, than the method of estimating cost by plinth area, because the cost of a building depends not only on its plinth area but also on the volume of the building. By this method the volume or cubic content of the proposed building is worked out and multiplied by the rate per cubic volume of similar buildings in that locality.

i) Determination of total volume in cubic metre: - total volume of building = Length X Breadth X Height.

ii) Determination of the rate per cubic metre: - the factors on which that rate of a building depends are the same as stated in the plinth area method.

## 3. Approximate quantities with bill method

Multiply the total length of the walls of a building in running metre by the cost of construction per metre length of such a wall. The total length of the walls of a building is worked out from the plan. The cost of the wall above and below the plinth level should be kept separate. It is better to find out the estimated cost separately

i) cost of wall including foundation and surface finishing
ii) cost of woodwork
iii) cost of flooring and
iv) cost of roofing.

## 4. Service unit or unit rate method

In this method all costs of a unit quantity such as per km for a highway, per metre span for a bridge, per classroom for school building, per bed for hospital, per litre for water tank, etc. are considered first and the estimate is prepared by multiplying the cost per corresponding unit by the number of units in the structure. Mainly the following considerations are made in preparations of an estimate by this method:

i) variation of price level,
ii) change I specification and location of site,
iii) number of units provided in the structures and
iv) Soil condition etc.

## 5. Bay method

In this method the approximate cost = number of bays in the proposed structure x cost of one such bay. Bays are compartments of similar portions of a structure when the area of a structure consists of similar cabins or parts such as a go-down, a railway platform, factory shades etc. which have been built up with intermediate columns or with roof trusses on walls placed at equal distances with the same roofing on top of those supporting members, then the area maybe divided from centre to centre of supports. Each such division may be treated as a bay. This is the most reliable approximate estimate that can be made. But the following points should be considered:

i) End bay should be considered separately due its end wall (gable wall).

ii) Current rate per bay should be worked out from the previous recorded rate.

iii) The location, specifications and drawings should be the same.

## 6. Cost comparison method

By this method approximate estimates are prepared for prototype structures or units consisting several works after comparing with the past records of expenses for such works. For example when prototype staff quarters or railway stations etc. are required to be estimated approximately then the estimate for such prototype works are prepared by comparing the previous cost with the present market rates, normally by increasing the past cost on a percentage basis. Such an estimate can be prepared quickly even during meetings. But expert knowledge is necessary to estimate the present cost of construction to the previous recorded cost.

## 7. Cost from materials and labour

In this method approximate quantities of materials and labour required per sq. m of the plinth area for a proposed building are worked out arbitrarily or with the help of the empirical equations b=developed by central building research institute (CBRI) and multiplied by the total plinth area of the building.

**BILL OF QUANTITIES**

This is a complete list of all items of work involved in connection with the estimate for a project with the description, quantity and unit of rate against each item of work. These are filled up in a tabular form similar to the abstract of estimated cost but the rate and amount column remain blank. The bill of quantities when multiplied by the corresponding rates of items and totalled, gives the estimated cost of the project. Such a bill of quantities is provided in a tender form for their item rate tenders. Contractors put up their own competitive rates and calculate the totals to offer their estimated amount to complete the whole work. The bill of quantities is also required to calculate the quantities of different materials required for the project.

**REQUIREMENTS FOR PREPARING ESTIMATION**

**a) Drawing: -**

The drawing is the basis from which quantities of various items for a work are calculated. So fully dimensioned drawings must be prepared showing plans, different sections and other relevant details for the work. For plans, sections and elevations: 1cm = 0.5m to 1cm = 2m and for detailed drawings 1cm = 1cm to 1cm = 20cm are the scales normally used.

**b) Specifications: -**

i) General specification

ii) Detailed specification (refer unit 1).

**c) Rates: -**

Quantities of different items of works are estimated from the drawing and these are multiplied by the rates. So, rates for different items of works are vital factors to determine the estimated cost. Normally the engineering department provide with current schedule of rates per unit of work, materials, wages of labour, transport etc. in case when such rate is not found in the schedule, this is worked out by analysis.

**d) Updated mode of measurement: -**

For standard deductions or additions are also necessary to determine the correct quantities of work.

**e) Standing circulars: -**

For taxes and insurance etc. are required to fix up rates of those items which are not in the schedule of works.

**FACTORS TO BE CONSIDERED FOR PREPARING ESTIMATE**

**a) Quantity of materials: -**

For a large construction, a large quantity of materials is required and this can be purchased at a rate cheaper than the rate of materials required for minor work. Therefore, rate of work should be framed considering the volume of work.

**b) Availability of materials: -**

Estimated cost of a particular item is higher than the schedule rate if there is no assurance that the materials will be available as and when required, and it is detrimental to the progress of the work if the workers and maintenance staff remain idle for paucity of materials.

**c) Transportation of materials: -**

If smaller quantities of materials are required to be transported to a considerable distance, the proportionate cost of transportation becomes higher in comparison with the cost of a larger quantity transported at a time.

**d) Location of site: -**

If the site of work is located at an odd place for which loading, unloading, stacking and restacking of materials are necessary, several times, due to different kinds of journey, the possibility of damage or loss in transit should be considered carefully.

**e) Local labour charges: -**

Skill and daily wages of the local labourers should be considered before preparation of a detailed estimate.

## PRINCIPLES OF MEASUREMENTS AND BILLING

i) Mass, voluminous and thick works shall be taken in cubic unit or volume (viz. cubic metre, cu m).

ii) Thin, shallow and surface work shall be in square unit or in area. The thickness shall be specified in the description of the item and the measurement of length and breadth of projection shall be taken to calculate the area.

iii) Long and thin work shall be taken in linear or running units, and linear measurement shall be taken

iv) Piece work, job work etc. shall be taken in number.

v) Dimensions shall be measure to the nearest 0.01m except for- thickness of slab or R.C. slab (0.005m); woodwork (0.002m); steel work (0.001m); reinforcement (0.005m); thickness of roadwork where the thickness is less than 20cm (0.005m).

vi) Areas shall be worked out to the nearest 0.01 sq. m. for steel work areas excluding cross- sectional measurements shall be worked out to nearest 0.001 sq. m

vii) Cubic contents shall be worked out to nearest 0.01 cu m except for woodwork shall be worked out to nearest 0.001 cu m.

viii) Weights shall be worked out to nearest 1 kg.

ix) Rates- The degree of accuracy in calculations depends upon the rate of the item of work. Thus, where the rates are per hundred or per thousand units, greater accuracy is not require. But where the rates are per metre or per running metre, per square metre, per cubic metre calculations should be carried up to two places of decimal for greater accuracy at higher rate.

## CONTINGENCIES

The term contingencies indicates the incidental expenses of a miscellaneous character which cannot be reasonably predicted during the preparation of the estimate; and to meet such unforeseen expenses an additional amount of 3% to 5% of the estimated cost of works is provided in the total estimate. The miscellaneous incidental expenses which cannot approximately be classified under nay distinct sub-head may be debited to the sub-head contingencies.

Where provision for a certain item is made on a lump sum basis, the amount to cover contingencies on execution of such items should be included in the lump sum amount itself. While determining the amount for contingencies as a percentage of the estimated cost, items where lump sum provisions have been made should be excluded from the cost.

## ELEMENTARY BILLING AND MEASUREMENT OF BASIC MATERIALS

| SL. NO | DESCRIPTION OF ITEM | UNIT OF MEASUREMENT | UNIT OF RATE | MODE OF MEASUREMENT |
|---|---|---|---|---|
| BRICKWORK | | | | |
| 1. | Brick of one or more than one brick wall. | Cu m | Per cu m | Thickness of brickwork shall be measured in multiples of half brick. All openings should be deducted. Brick work circular on plan more than 6m radius shall be measured separately. Brick work at different levels should be measured separately. |
| 2. | Brick work in arches | Cu m | Per cu m | Measurements is required separately to provide extra over rates of corresponding items for brick work in arches. |
| 3. | Reinforced brick work | Cu m | Per cu m | Unless otherwise stated reinforcement and timber work shall be measured separately. |
| 4. | Honeycomb brick work | Sq. m | Per sq. m | The thickness of the wall and the pattern of honey combing shall be stated. Honey comb openings shall not be deducted. |
| 5. | 10cm or half brick wall | Sq. m | Per sq. m | Brick on the edge wall should also be paid in sq. m. wire netting etc. if provided shall be |

| | | | | |
|---|---|---|---|---|
| | | | | included in the item. |
| 6. | Brick flat soiling | Sq. m | Per sq. m | The item shall include filling the gaps between by sand etc. |
| 7. | Cornices, string courses, drip courses etc. | Rm | Per rm | Depth and width of the projection shall be fully described. Plastering, moulding etc. shall be included in the item. |
| 8. | Cutting holes through existing brick work | Per cm | Per cm | Rates for cutting holes shall be given per cm depth separately. |
| 9. | Cutting openings in existing brick work | Cu m | Per cu m | Cutting openings exceeding 0.1 sq. m in area including the provision for fixing and removal of temporary support and shoring shall be included in the item. |
| CONCRETE | | | | |
| 1. | Lime or cement concrete in foundation | Cu m | Per cu m | Works of lime concrete shall be fully described. |
| 2. | Reinforce cement concrete | Cu m | Per cu m | Each class of work shall be measured separately. Unless stated otherwise frame work and reinforcement shall be measured separately. |
| 3. | Form work | Sq. m | Per sq. m | Unless stated otherwise formwork shall be classified and measured separately. |
| 4. | Reinforcement | Quintal | Per quintal | Shall include the standard length for hooking ends, cranking, and overlapping and cutting to the length or bending or binding. Binding ire is |

| | | | | |
|---|---|---|---|---|
| | | | | included. |
| 5. | Damp proof course | Sq. m | Per sq. m | Measurements shall be taken stating the thickness. |
| 6. | R.C. chajja sun shade | Cu m | Per cu m | Where chajja is combined with the beam or lintel the common portion shall be measured as chajja. |
| 7. | Precast C.C. or R.C.C. blocks | Cu m | Per cu m | Form work or moulds shall be deemed to be included with items. Precast units shall be enumerated. |
| 8. | Solid block work | Cu m | cu m | May also be measured in sq. m stating thickness |
| 9. | Hollow concrete block wall | Cu m | cu m | No deduction shall be made for the hollows in the blocks. |
| 10. | Expansion joints in concrete | R m | Per r m | Expansion joins in roofs, floors, walls, roads etc. shall be given in r m stating the width and depth of the joint and the material used in filling the joint. |
| 11. | Concrete jaffries or allies | Sq. m | Per sq. m | The thickness and other particulars of the jaffries shall be described. The reinforcement, shuttering shall be described and included in the item. |
| 12. | Concrete fencing posts, terminal posts etc. | Cu m | Per cu m | Reinforcement shall be described and included with the item. |
| WOODWORK | | | | |
| 1. | Door and window shutter of different types | Sq. m | Per sq. m | Net measurement shall be taken as per opening in the frame work including rebate but |

| | | | | |
|---|---|---|---|---|
| | | | | excluding extra width for rebate or splayed meeting styles of doors and windows. |
| 2. | Woodwork in door and window frames | Cu m | Per cu m | Net measurement shall be taken as per opening and including the length of joints, horn etc. no deduction shall be made for rebating, chamfers etc. |
| 3. | Shuttering, centring | Sq. m | Per sq. m | Measurement shall be taken on area in actual contact with concrete. The description of frame work shall include all supports, struts, braces, battens, nails etc. |
| 4. | Scantling, battens, trusses etc. | Cu m | Per cu m | Framed and fixed timber shall include lapping, notching, boring for bolts, hoisting, erecting and fixing. |
| 5. | Handrail | R m | Per r m | Measurement shall be taken along top centre line. |
| 6. | Boarding as roof boarding, ceiling, floors. | Sq. m | Per sq. m | Measurements shall be taken stating the finished thickness and shall be fully described. |
| 7. | Ballies | R m | Per r m | Mean diameter shall be stated. The mean diameter shall be the average of the two diameters at the ends. |
| 8. | Wood piles | R m | Per r m | Length over 6m shall be measured in stages of 1m. |

# RATE ANALYSIS

## Rate Analysis

The process of determining rate per unit of any work in Civil Engineering project like earthwork, concrete work, brickwork, plastering, painting etc. is known as Analysis of Rates or simply Rate Analysis. The rates of materials and labour vary from place to place and hence the rates of different items of works also vary from place to place. The rates of these works further help in determining cost of particular work and in turn cost of the project.

## Necessity of Rate Analysis

- To determine the actual cost per unit of the items.
- To work out the economical use of materials and processes in completing the particulars item.
- To calculate the cost of extra items which are not provided in the contract bond, but are to be executed as per the directions of the department.
- To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

## Factors Deciding Rate of Items

The various factors that are involved in determining rate of any item, process or work are mentioned below:

- Specifications of works and material about their quality, proportion and constructional operation method.
- Quantity of materials and their costs.
- Cost of labour and their wages.
- Location of site of work and the distances from source and conveyance charges.
- Overhead and establishment charges
- Profit and miscellaneous expenses of the contractor

**Procedure of Rate Analysis**

The analysis of rates is worked out for the unit payment of the particular item of work under two heads: Materials and Labour.

- The cost of items of work = Material cost + Labour cost
- Other costs included to the above cost of items of work are:
  - ✓ Tools and Plants ( T & P ) = 2.5 to 3 % of the labour cost
  - ✓ Transportation cost (if conveyance more than 8 km is considered.)
  - ✓ Water charges = 1.5 to 2 % 0f total cost
  - ✓ Contractor"s profit = 10 %

## UNIT WEIGHT OF THE CONSTRUCTION MATERIALS

| S.No | Material | Theoretical Weight in(KG/M³) | Approx Weight at Site in | | Remarks |
|---|---|---|---|---|---|
| | | | Kg | Per | |
| 1 | Cement | 1440 | 50 | Bag | |
| 2 | Steel | 7850 | $d^2/162$ | | d -dia in mm |
| 3 | Sand- | | | | |
| | Dry | 1600 | 50 to 55 | farma | 1 farma=1.25cft |
| | River | 1840 | 57 to 63 | farma | 1 farma=1.25cft |
| 4 | Stone(basalt) | 2850 to 2960 | 48 to 52 | farma | metal 12mm to 20mm |
| 5 | Water | 1000 | 1 | liter | |
| 6 | PCC | 2240 | 8.24 to 8.5 | Cube mould | cube mould size=15x15x15cm |
| 7 | RCC 2% Steel | 2420 | | | |
| 8 | Bricks | 1600 to 1920 | 1.9 to 2 | no | 9x4x2 3/4" |
| | | | 4.8 to 4.9 | no | 9x6x3 3/4" |

| | | | | | |
|---|---|---|---|---|---|
| 9 | Brick Masonry | 1920 | | | |
| 10 | Soil(damp) | 1760 | 50 to 55 | cft | Black cotton |
| 11 | Cement concrete block(solid) | 1800 | 18 to 20 | cft | 30x15x20 cm |
| | | | 10 to 11 | no | 30x10x20 cm |
| 12 | Cement Mortar | 2080 | 57 to 62 | cft | |
| 13 | Lime Mortar | 1760 | 48 to 52 | cft | |
| 14 | Lime | 640 | 30 | bag | |
| 15 | Glass | 2530 | 0.9 to 0.95 | sft | 4mm tk plain |
| 16 | Teak Wood | 670 to 830 | 18 to 20 | cft | |
| 17 | Sal Wood | 990 | 22 to 24 | cft | |
| 18 | Marble mosaic tile | | 2.8 to 3.2 | no | 25x25x22mm |
| | | | 4.8 to 5.2 | no | 30x30x25mm |
| 19 | Chequered tile | | 2.5 to 2.8 | no | 25x25x22mm |
| 20 | Glazed tile15x15cm | | 0.20 to 0.25 | no | 5mm tk |
| 21 | Marble Stone | 2620 | 5.1 | sft | 3/4"tk |
| 22 | Granite Stone | 2460-2800 | 5.35 | sft | 3/4"tk |
| 23 | Coddappa | 2720 | 6.4 | sft | 1 1/4"tk |
| 24 | A.C.sheet corrugated | 16 | 1.2 | sft | |
| 25 | Bitumen | 1040 | 220 | Drum | 200liter drum |
| 26 | Window frame (simple design) | | 1.9 to2.1 | sft | |
| 27 | Door Frame | | | | |
| | a)3"00×7"0 | | 25 to 27 | no | section 4"x2 1/2" |
| | b)2"6"x7"0 | | 24 to 26 | no | section 4"x2 1/2" |

## Cement concrete

The materials required for cement concrete are broken stone ( coarse aggregate), sand (fine aggregate) and cement. The requirement of these materials for a given volume of concrete may be approximately determined by a thumb rule.

By field experiments, it is found that a total volume of 1.57 $m^3$ of ingredients, when mixed together together water, give 1m3 of concrete with 20 mm size broken stone as coarse aggregate. The total volume of ingredients required when 40 mm size broken stone is used 1.52$m^3$ .

### Cement concrete 1:1.5:3 (20 mm size aggregate) -1$m^3$

| | |
|---|---|
| Ratio of ingredients by volume | = 1:1.5:3 (5.5 parts) |
| Total volume of ingredients | = 1.57 $m^3$ |
| Volume of broken stone required | = 3/5.5 x 1.57 |
| | = 0.856 $m^3$ |
| Volume of and required | = 1.5/5.5 x1.57 |
| | = 0.428 $m^3$ |
| Volume of cement required | = 1/5.5 x 1.57 |
| | = 0.285 $m^3$ |
| Weight of cement required | = 0.285 x 1440 |
| | = 410 Kg |

### Cement concrete 1:5:10 (40 mm size aggregate) -1$m^3$

| | |
|---|---|
| Ratio of ingredients by volume | = 1:5:10 (16 parts) |
| Total volume of ingredients | = 1.52 $m^3$ |
| Volume of broken stone required | = 10/16 x 1.52 |
| | = 0.95 $m^3$ |

Volume of and required = 5/16 x1.52

= 0.475 $m^3$

Volume of cement required = 1/16 x 1.52

= 0.095 $m^3$

Weight of cement required = 0.095 x 1440

= 137 Kg

## I class Brick work in cement mortar – 1$m^3$

Let us consider I class brickwork with 190x90x90 mm size stock bricks. It is assumed that, with mortar thickness all-round, a brick attain a net size of 200 x 100 x 100 mm (Thickness of mortar layer 10mm)

Net volume of 1 stock brick = 0.2 x 0.1 x 0.1

= 0.002 $m^3$

No. of bricks required for 1 $m^3$ of brickwork = 1/0.002

= 500

Actual volume of bricks in 1$m^3$ of brickwork = 500 x 0.19 x 0.09 x 0.09

= 0.7695 $m^3$

The volume of cement mortar = 1 - 0.7695

= 0.23 $m^3$

(Sand = 0.23 $m^3$ , Cement = According to mortar ratio)

## Plastering with C.M 1: 6, 12 mm thick – 100 $m^2$

Area to be plastered = 100 $m^2$

Thickness of mortar layer = 12 mm = 0.0012 m

Volume of mortar required = 100 X 0.012

= 1.20 $m^3$

Add 20 % for allowance for undulation

of surface and wastage = $1.20 \times \frac{20}{100} = 0.24\ m^3$

Total volume of mortar required = 1.20 + 0.24

= $1.44\ m^3$

Add 1/3 volume for dry mortar = $1.44 + (\frac{1}{3} \times 1.44)$

= $1.92\ m^3$ (dry)

Summation of proportion = 1+6 = 7

Required cement = 1.92/7

= $0.274\ m^3$

Required sand = 0.274 x 6

= $1.64\ m^3$

## Reinforcement for R.C works

R.C columns = 1.5 % to 2.0 % (60 to 120 Kg/ $m^3$)

R.C beams = 1.0% to 1.5 % (80 to 120 Kg/ $m^3$)

R.C slabs = 0.5 % to 1.0 % (40 to 80 Kg/ $m^3$)

R.C footing = 0.5 % (40 Kg/ $m^3$)

## Cost Estimation

### Costs Associated with Constructed Facilities

The costs of a constructed facility to the owner include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components.

The capital cost for a construction project includes the expenses related to the initial establishment of the facility:

- Land acquisition, including assembly, holding and improvement
- Planning and feasibility studies
- Architectural and engineering design

- Construction, including materials, equipment and labor
- Field supervision of construction
- Construction financing
- Insurance and taxes during construction
- Owner's general office overhead
- Equipment and furnishings not included in construction
- Inspection and testing

The operation and maintenance cost in subsequent years over the project life cycle includes the following expenses:

- Land rent, if applicable
- Operating staff
- Labor and material for maintenance and repairs
- Periodic renovations
- Insurance and taxes
- Financing costs
- Utilities
- Owner's other expenses

The magnitude of each of these cost components depends on the nature, size and location of the project as well as the management organization, among many considerations. The owner is interested in achieving the lowest possible overall project cost that is consistent with its investment objectives.

It is important for design professionals and construction managers to realize that while the construction cost may be the single largest component of the capital cost, other cost components are not insignificant. For example, land acquisition costs are a major expenditure for building construction in high-density urban areas, and construction financing costs can reach the same order of magnitude as the construction cost in large projects such as the construction of nuclear power plants.

From the owner's perspective, it is equally important to estimate the corresponding operation and maintenance cost of each alternative for a proposed facility in order to analyze the life cycle costs. The large expenditures needed for facility maintenance, especially for publicly owned infrastructure, are reminders of the neglect in the past to consider fully the implications of operation and maintenance cost in the design stage.

In most construction budgets, there is an allowance for contingencies or unexpected costs occurring during construction. This contingency amount may

be included within each cost item or be included in a single category of construction contingency. The amount of contingency is based on historical experience and the expected difficulty of a particular construction project. For example, one construction firm makes estimates of the expected cost in five different areas:

- Design development changes,
- Schedule adjustments,
- General administration changes (such as wage rates),
- Differing site conditions for those expected, and
- Third party requirements imposed during construction, such as new permits.

Contingent amounts not spent for construction can be released near the end of construction to the owner or to add additional project elements.

In this chapter, we shall focus on the estimation of construction cost, with only occasional reference to other cost components. In Chapter 6, we shall deal with the economic evaluation of a constructed facility on the basis of both the capital cost and the operation and maintenance cost in the life cycle of the facility. It is at this stage that tradeoffs between operating and capital costs can be analyzed.

## Approaches to Cost Estimation

Cost estimating is one of the most important steps in project management. A cost estimate establishes the base line of the project cost at different stages of development of the project. A cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data. According to the American Association of Cost Engineers, cost engineering is defined as that area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to the problem of cost estimation, cost control and profitability.

Virtually all cost estimation is performed according to one or some combination of the following basic approaches:

### Production function

In microeconomics, the relationship between the output of a process and the necessary resources is referred to as the production function. In construction, the production function may be expressed by the relationship between the volume of construction and a factor of production such as labor or

capital. A production function relates the amount or volume of output to the various inputs of labor, material and equipment. For example, the amount of output Q may be derived as a function of various input factors $x_1$, $x_2$, ..., $x_n$ by means of mathematical and/or statistical methods. Thus, for a specified level of output, we may attempt to find a set of values for the input factors so as to minimize the production cost. The relationship between the size of a building project (expressed in square feet) to the input labor (expressed in labor hours per square foot) is an example of a production function for construction. Several such production functions are shown in Figure 3-3 of Chapter 3.

**Empirical cost inference**

Empirical estimation of cost functions requires statistical techniques which relate the cost of constructing or operating a facility to a few important characteristics or attributes of the system. The role of statistical inference is to estimate the best parameter values or constants in an assumed cost function. Usually, this is accomplished by means of regression analysis techniques.

**Unit costs for bill of quantities**

A unit cost is assigned to each of the facility components or tasks as represented by the bill of quantities. The total cost is the summation of the products of the quantities multiplied by the corresponding unit costs. The unit cost method is straightforward in principle but quite laborious in application. The initial step is to break down or disaggregate a process into a number of tasks. Collectively, these tasks must be completed for the construction of a facility. Once these tasks are defined and quantities representing these tasks are assessed, a unit cost is assigned to each and then the total cost is determined by summing the costs incurred in each task. The level of detail in decomposing into tasks will vary considerably from one estimate to another.

**Allocation of joint costs**

Allocations of cost from existing accounts may be used to develop a cost function of an operation. The basic idea in this method is that each expenditure item can be assigned to particular characteristics of the operation. Ideally, the allocation of joint costs should be causally related to the category of basic costs in an allocation process. In many instances, however, a causal relationship between the allocation factor and the cost item cannot be identified or may not exist. For example, in construction projects, the accounts for basic costs may be classified according to (1) labor, (2) material, (3) construction equipment,

(4) construction supervision, and (5) general office overhead. These basic costs may then be allocated proportionally to various.

## Types of Construction Cost Estimates

Construction cost constitutes only a fraction, though a substantial fraction, of the total project cost. However, it is the part of the cost under the control of the construction project manager. The required levels of accuracy of construction cost estimates vary at different stages of project development, ranging from ball park figures in the early stage to fairly reliable figures for budget control prior to construction. Since design decisions made at the beginning stage of a project life cycle are more tentative than those made at a later stage, the cost estimates made at the earlier stage are expected to be less accurate. Generally, the accuracy of a cost estimate will reflect the information available at the time of estimation.

Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control. For establishing the financing of a project, either a design estimate or a bid estimate is used.

1. **Design Estimates.** For the owner or its designated design professionals, the types of cost estimates encountered run parallel with the planning and design as follows:
    - Screening estimates (or order of magnitude estimates)
    - Preliminary estimates (or conceptual estimates)
    - Detailed estimates (or definitive estimates)
    - Engineer's estimates based on plans and specifications

    For each of these different estimates, the amount of design information available typically increases.

2. **Bid Estimates.** For the contractor, a bid estimate submitted to the owner either for competitive bidding or negotiation consists of direct construction cost including field supervision, plus a markup to cover general overhead and

profits. The direct cost of construction for bid estimates is usually derived from a combination of the following approaches.

- Subcontractor quotations
- Quantity takeoffs
- Construction procedures.

3. **Control Estimates.** For monitoring the project during construction, a control estimate is derived from available information to establish:
   - Budget estimate for financing
   - Budgeted cost after contracting but prior to construction
   - Estimated cost to completion during the progress of construction.

**Design Estimates**

In the planning and design stages of a project, various design estimates reflect the progress of the design. At the very early stage, the *screening estimate* or *order of magnitude* estimate is usually made before the facility is designed, and must therefore rely on the cost data of similar facilities built in the past. A *preliminary estimate* or *conceptual estimate* is based on the conceptual design of the facility at the state when the basic technologies for the design are known. The *detailed estimate* or *definitive estimate* is made when the scope of work is clearly defined and the detailed design is in progress so that the essential features of the facility are identifiable. The *engineer's estimate* is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors. In preparing these estimates, the design professional will include expected amounts for contractors' overhead and profits.

The costs associated with a facility may be decomposed into a hierarchy of levels that are appropriate for the purpose of cost estimation. The level of detail in decomposing the facility into tasks depends on the type of cost estimate to be prepared. For conceptual estimates, for example, the level of detail in defining tasks is quite coarse; for detailed estimates, the level of detail can be quite fine.

As an example, consider the cost estimates for a proposed bridge across a river. A screening estimate is made for each of the potential alternatives, such as a tied arch bridge or a cantilever truss bridge. As the bridge type is selected, e.g. the technology is chosen to be a tied arch bridge instead of some new bridge form, a preliminary estimate is made on the basis of the layout of the selected bridge form on the basis of the preliminary or conceptual design. When the detailed design has progressed to a point when the essential details are known, a detailed estimate is made on the basis of the well defined scope of the project.

When the detailed plans and specifications are completed, an engineer's estimate can be made on the basis of items and quantities of work.

**Bid Estimates**

The contractor's bid estimates often reflect the desire of the contractor to secure the job as well as the estimating tools at its disposal. Some contractors have well established cost estimating procedures while others do not. Since only the lowest bidder will be the winner of the contract in most bidding contests, any effort devoted to cost estimating is a loss to the contractor who is not a successful bidder. Consequently, the contractor may put in the least amount of possible effort for making a cost estimate if it believes that its chance of success is not high.

If a general contractor intends to use subcontractors in the construction of a facility, it may solicit price quotations for various tasks to be subcontracted to specialty subcontractors. Thus, the general subcontractor will shift the burden of cost estimating to subcontractors. If all or part of the construction is to be undertaken by the general contractor, a bid estimate may be prepared on the basis of the quantity takeoffs from the plans provided by the owner or on the basis of the construction procedures devised by the contractor for implementing the project. For example, the cost of a footing of a certain type and size may be found in commercial publications on cost data which can be used to facilitate cost estimates from quantity takeoffs. However, the contractor may want to assess the actual cost of construction by considering the actual construction procedures to be used and the associated costs if the project is deemed to be different from typical designs. Hence, items such as labor, material and equipment needed to perform various tasks may be used as parameters for the cost estimates.

**Control Estimates**

Both the owner and the contractor must adopt some base line for cost control during the construction. For the owner, a *budget estimate* must be adopted early enough for planning long term financing of the facility. Consequently, the detailed estimate is often used as the budget estimate since it is sufficient definitive to reflect the project scope and is available long before the engineer's estimate. As the work progresses, the budgeted cost must be revised periodically to reflect the estimated cost to completion. A revised estimated cost is necessary either because of change orders initiated by the owner or due to unexpected cost overruns or savings.

For the contractor, the bid estimate is usually regarded as the budget estimate, which will be used for control purposes as well as for planning construction

financing. The budgeted cost should also be updated periodically to reflect the estimated cost to completion as well as to insure adequate cash flows for the completion of the project.

## Effects of Scale on Construction Cost

Screening cost estimates are often based on a single variable representing the capacity or some physical measure of the design such as floor area in buildings, length of highways, volume of storage bins and production volumes of processing plants. Costs do not always vary linearly with respect to different facility sizes. Typically, scale economies or diseconomies exist. If the average cost per unit of capacity is declining, then scale economies exist. Conversely, scale diseconomies exist if average costs increase with greater size. Empirical data are sought to establish the economies of scale for various types of facility, if they exist, in order to take advantage of lower costs per unit of capacity.

### Unit Cost Method of Estimation

If the design technology for a facility has been specified, the project can be decomposed into elements at various levels of detail for the purpose of cost estimation. The unit cost for each element in the bill of quantities must be assessed in order to compute the total construction cost. This concept is applicable to both design estimates and bid estimates, although different elements may be selected in the decomposition.

For design estimates, the unit cost method is commonly used when the project is decomposed into elements at various levels of a hierarchy as follows:

1. **Preliminary Estimates**. The project is decomposed into major structural systems or production equipment items, e.g. the entire floor of a building or a cooling system for a processing plant.
2. **Detailed Estimates**. The project is decomposed into components of various major systems, i.e., a single floor panel for a building or a heat exchanger for a cooling system.
3. **Engineer's Estimates**. The project is decomposed into detailed items of various components as warranted by the available cost data. Examples of detailed items are slabs and beams in a floor panel, or the piping and connections for a heat exchanger.

For bid estimates, the unit cost method can also be applied even though the contractor may choose to decompose the project into different levels in a hierarchy as follows:

1. **Subcontractor Quotations**. The decomposition of a project into subcontractor items for quotation involves a minimum amount of work for the general contractor. However, the accuracy of the resulting estimate depends on the reliability of the subcontractors since the general contractor selects one among several contractor quotations submitted for each item of subcontracted work.
2. **Quantity Takeoffs**. The decomposition of a project into items of quantities that are measured (or *taken off*) from the engineer's plan will result in a procedure similar to that adopted for a detailed estimate or an engineer's estimate by the design professional. The levels of detail may vary according to the desire of the general contractor and the availability of cost data.
3. **Construction Procedures**. If the construction procedure of a proposed project is used as the basis of a cost estimate, the project may be decomposed into items such as labor, material and equipment needed to perform various tasks in the projects.

## Cost Indices

It is important to note the price level changes over time. Trends in price changes can also serve as a basis for forecasting future costs. The input price indices of labor and/or material reflect the price level changes of such input components of construction; the output price indices, where available, reflect the price level changes of the completed facilities, thus to some degree also measuring the productivity of construction.

A price index is a weighted aggregate measure of constant quantities of goods and services selected for the package. The price index at a subsequent year represents a proportionate change in the same weighted aggregate measure because of changes in prices. Let $I_t$ be the price index in year t, and $I_{t+1}$ be the price index in the following year t+1. Then, the percent change in price index for year t+1 is:

$$i_{t+1} = \frac{I_{t+1} - I_t}{I_t}(100\%)$$

or

$$I_{t=1} = I_t(1 + j_{t+1})$$

If the price index at the base year t=0 is set at a value of 100, then the price indices $I_1$, $I_2$...$I_n$ for the subsequent years t=1,2...n can be computed successively from changes in the total price charged for the package of goods measured in the index.

The best-known indicators of general price changes are the Gross Domestic Product (GDP) deflators compiled periodically by the U.S. Department of Commerce, and the consumer price index (CPI) compiled periodically by the U.S. Department of Labor. They are widely used as broad gauges of the changes in production costs and in consumer prices for essential goods and services. Special price indices related to construction are also collected by industry sources since some input factors for construction and the outputs from construction may disproportionately outpace or fall behind the general price indices. Examples of special price indices for construction input factors are the wholesale Building Material Price and Building Trades Union Wages, both compiled by the U.S. Department of Labor.

In addition, the construction cost index and the building cost index are reported periodically in the *Engineering News-Record (ENR)*. Both ENR cost indices measure the effects of wage rate and material price trends, but they are not adjusted for productivity, efficiency, competitive conditions, or technology changes. Consequently, all these indices measure only the price changes of respective construction *input factors* as represented by constant quantities of material and/or labor. On the other hand, the price indices of various types of completed facilities reflect the price changes of construction output including all pertinent factors in the construction process. The building construction output indices compiled by Turner Construction Company and Handy-Whitman Utilities are compiled in the U.S. *Statistical Abstracts* published each year.

## Applications of Cost Indices to Estimating

In the screening estimate of a new facility, a single parameter is often used to describe a cost function. For example, the cost of a power plant is a function of electricity generating capacity expressed in megawatts, or the cost of a

sewage treatment plant as a function of waste flow expressed in million gallons per day.

The general conditions for the application of the single parameter cost function for screening estimates are:

1. Exclude special local conditions in historical data
2. Determine new facility cost on basis of specified size or capacity (using the methods described in Sections 5.3 to 5.6)
3. Adjust for inflation index
4. Adjust for local index of construction costs
5. Adjust for different regulatory constraints
6. Adjust for local factors for the new facility

Some of these adjustments may be done using compiled indices, whereas others may require field investigation and considerable professional judgment to reflect differences between a given project and standard projects performed in the past.

## Estimate Based on Engineer's List of Quantities

The engineer's estimate is based on a list of items and the associated quantities from which the total construction cost is derived. This same list is also made available to the bidders if unit prices of the items on the list are also solicited from the bidders. Thus, the itemized costs submitted by the winning contractor may be used as the starting point for budget control.

In general, the progress payments to the contractor are based on the units of work completed and the corresponding unit prices of the work items on the list. Hence, the estimate based on the engineers' list of quantities for various work items essentially defines the level of detail to which subsequent measures of progress for the project will be made.

## Allocation of Construction Costs Over Time

Since construction costs are incurred over the entire construction phase of a project, it is often necessary to determine the amounts to be spent in various periods to derive the cash flow profile, especially for large projects with long durations. Consequently, it is important to examine the percentage of work expected to be completed at various time periods to which the costs would be charged. More accurate estimates may be accomplished once the project is scheduled as described in Chapter 10, but some rough estimate of the cash flow may be required prior to this time.

Consider the basic problem in determining the percentage of work completed during construction. One common method of estimating percentage of completion is based on the amount of money spent relative to the total amount budgeted for the entire project. This method has the obvious drawback in assuming that the amount of money spent has been used efficiently for production.

A more reliable method is based on the concept of *value of work completed* which is defined as the product of the budgeted labor hours per unit of production and the actual number of production units completed, and is expressed in budgeted labor hours for the work completed. Then, the percentage of completion at any stage is the ratio of the value of work completed to date and the value of work to be completed for the entire project. Regardless of the method of measurement, it is informative to understand the trend of work progress during construction for evaluation and control.

## Computer Aided Cost Estimation

Numerous computer aided cost estimation software systems are now available. These range in sophistication from simple spreadsheet calculation software to integrated systems involving design and price negotiation over the Internet. While this software involves costs for purchase, maintenance, training and computer hardware, some significant efficiencies often result. In particular, cost estimates may be prepared more rapidly and with less effort.

Some of the common features of computer aided cost estimation software include:

- Databases for unit cost items such as worker wage rates, equipment rental or material prices. These databases can be used for any cost estimate required. If these rates change, cost estimates can be rapidly re-computed after the databases are updated.
- Databases of expected productivity for different components types, equipment and construction processes.
- Import utilities from computer aided design software for automatic quantity-take-off of components. Alternatively, special user interfaces may exist to enter geometric descriptions of components to allow automatic quantity-take-off.
- Export utilities to send estimates to cost control and scheduling software. This is very helpful to begin the management of costs during construction.

- Version control to allow simulation of different construction processes or design changes for the purpose of tracking changes in expected costs.
- Provisions for manual review, over-ride and editing of any cost element resulting from the cost estimation system
- Flexible reporting formats, including provisions for electronic reporting rather than simply printing cost estimates on paper.
- Archives of past projects to allow rapid cost-estimate updating or modification for similar designs.

A typical process for developing a cost estimate using one of these systems would include:

1. If a similar design has already been estimated or exists in the company archive, the old project information is retrieved.
2. A cost engineer modifies, adds or deletes components in the project information set. If a similar project exists, many of the components may have few or no updates, thereby saving time.
3. A cost estimate is calculated using the unit cost method of estimation. Productivities and unit prices are retrieved from the system databases. Thus, the latest price information is used for the cost estimate.
4. The cost estimation is summarized and reviewed for any errors.

## Estimation of Operating Costs

In order to analyze the life cycle costs of a proposed facility, it is necessary to estimate the operation and maintenance costs over time after the startup of the facility. The stream of operating costs over the life of the facility depends upon subsequent maintenance policies and facility use. In particular, the magnitude of routine maintenance costs will be reduced if the facility undergoes periodic repairs and rehabilitation at periodic intervals.

Since the tradeoff between the capital cost and the operating cost is an essential part of the economic evaluation of a facility, the operating cost is viewed not as a separate entity, but as a part of the larger parcel of life cycle cost at the planning and design stage. The techniques of estimating life cycle costs are similar to those used for estimating capital costs, including empirical cost functions and the unit cost method of estimating the labor, material and equipment costs.

However, it is the interaction of the operating and capital costs which deserve special attention.

As suggested earlier in the discussion of the exponential rule for estimating, the value of the cost exponent may influence the decision whether extra capacity should be built to accommodate future growth. Similarly, the economy of scale may also influence the decision on rehabilitation at a given time. As the rehabilitation work becomes extensive, it becomes a capital project with all the implications of its own life cycle. Hence, the cost estimation of a rehabilitation project may also involve capital and operating costs.

While deferring the discussion of the economic evaluation of constructed facilities to Chapter 6, it is sufficient to point out that the stream of operating costs over time represents a series of costs at different time periods which have different values with respect to the present. Consequently, the cost data at different time periods must be converted to a common base line if meaningful comparison is desired.

# UNIT IV

# VALUATION

**Definition**

Valuation is the technique of determination of fair price of a property such as land, building, factory or other structures. Valuation determines present value of the property for sale or renting purpose.

**Difference between Cost, Price and Value**

- Cost means the original cost of construction minus the loss due to its age and change in taste or fashion.
- Price is the amount calculated adding the cost of the production, interest on investment and profit to the producer or the owner.
- Value is the worth or utility of a property. Value of a property depends largely on the demand and supply.

For example the cost to draw a painting may be 1,000/- rupees, but by adding profit for the painter the price may be fixed at 1,500/- rupees. Let us consider the painting is a very famous painting whose demand is more (like Monalisa by Leonardo da Vinci) then the value of the painting may be significantly high.

## Purpose of the Valuation

The main purposes of valuation are as follows:

- Sale or Purchase of a property
- To fix up the municipal taxes, wealth tax and estate duty on a property
- To fix up the gift tax payable to the govt when the property is gifted to somebody else.
- To probate, i.e. to prove before a court that the written paper purporting to be the will of a person who has died is indeed his lawful act the official copy of a will is to be presented along with court stamp

fees. The stamp fee depends on the value of a property and for this valuation is necessary.

- To divide the property among the shareholders in case of the partition.
- Assessment of income or stamp duty.
- To pay the capital gains tax when a capital asset is disposed of and the proceeds exceed the costs incurred in acquiring the asset.
- Rent Fixation
- To work out the insurance value of a property
- To determine the quantum of loan that can be sanctioned against a property as mortgage or security
- For compulsory acquisition of the property by govt. for public purpose.
- To determine the speculative value of a property, i.e. the purchase of a property with intention to sale at a later date and to make some profit.
- To fix up the betterment charges, i.e. construction of new road, providing market complex, community hall etc. so that the value of the property will increase.

**Terminology**

**1. Incomes:**

**a) Gross income:** Total income from all sources.

**b) Outgoings:** these are the expenses which are required to be incurred to maintain the property. These includes: Taxes, periodic repairs, management and collection charges, sinking fund, and loss of rent (for the period when the property is not occupied).

**c) Net income:** The amount left after deducting all outgoings from the gross income.

**d)** Net income = gross income- outgoings.

**e) Perpetual income**: It is the income receivable for indefinite period of time.

**f) Deferred Income:** it is the income receivable after a lapse of certain period.

**2. Scrap value**

If a building is to be dismantled after the period its utility is over, some amount can be fetched from the sale of old materials. The amount is known as scrap value of a building. Scrap value varies from 7% to 10% of the cost of construction according to the availability of the material.

**3. Salvage value**

If a property after being discarded at the end of the utility period is sold without being into pieces, the amount thus realized by sale is known as its salvage

| Scrap value | Salvage value |
|---|---|
| This is the dismantled sale value of the materials of an asset at the end of its useful life. | This is the estimated value of an asset as a whole without dismantling at the end of its useful life. |
| Scrap value is counted in the calculation of depreciation of a property at the end of the useful life and usually this is considered 10% of the cost of the structure or on lump sum basis. | Ordinarily the salvage value factor in the calculation is omitted by accounting scrap value |
| Scrap value of an asset is merely sale of scarp and has a limitation. | Salvage value deposition may take the form of a sale of the asset to a purchaser who will continue to use it for the function for which it was originally designed. In this case salvage value dominate scrap value in the calculation of depreciation |
| Scarp value is not counted as a minus quantity. | There are time when it may be a minus quantity |

**4. Year's purchase**

It may be as the figure which when multiplied by the net income from a property gives capitalized value of the property. It can also be defined as "a certain amount of capital whose annuity of Rs.1/- at a certain rate of interest can be received" Year"s purchase = 100/rate of interest = 1/i

**5. Capitalized value**

It is defined as that amount of money whose annual interest at the highest prevailing rate will be equal to the net income received from the property. To calculate the capitalized value, it is necessary to know highest prevailing on such properties and income from the property.

Example: Calculate the capitalized value of a property fetching a net annual rent of 25000 and the highest rate of interest prevalent being 7%.

Ans: Net annual rent = 25,000

Rate of interest = 8%

In order to get an annual interest equal to the net annual rent of Rs. 25,000

(8/100) * X = 25000

X = 25000 * (100/8) = 3, 12, 500.00

Capitalized value = Net annual income * Year"s purchase (Ans.)

**6. Obsolescence**

The value of property decreases if its style and design are outdated i.e rooms not properly set, thick walls, poor ventilation etc. The reason of this is fast changing techniques of construction, design, ideas leading to more comfort etc.

## 7. Market value

The market value of a property is the amount, which can be obtained at any particular time from the open market if the property is put for sale. The market value will differ from time to time according to demand and supply.

## 8. Book value

Book value is the amount shown in the account book after allowing necessary depreciations. The book value of a property at a particularly year is the original cost minus the amount of depreciation up to the previous year.

| Market Value | Book Value |
|---|---|
| Value is fixed by the purchaser | Value is fixed by the depreciation |
| Value is higher during the subsequent years due to increase in price index | Book value cannot be higher during subsequent years even due to the increase of price index. |
| Value may be constant for a period | Value cannot be constant, rather there is a gradual fall |
| Applicable to any type of property | This cannot be applicable in case of land or metal articles like steel copper or gold etc. |
| Market value is considered for the valuation | Book value is considered for the accounts book of a company |
| Depends on the forces of demand and supply | Book value does not vary due to demand and supply |

## 9. Annuity

It is defined as the return of capital investment in the shape of annual installment"s monthly, quarterly, half-yearly and yearly. It is the annual payments for the repayment of the capital amount invested by a party. These annual payments are made at the beginning or end of a year, usually, for a specific number of years.

- ✓ **Annuity Certain:** If the amount of the annuity is paid for a definite number of years. The lesser the number of year higher the annuity and vice versa.

- ✓ **Annuity Due:** If the amount of annuity is paid at the beginning of each period or year and payments are continued for definite number of periods.

- ✓ **Deferred Annuity**: If the payment of the amount of annuity begins at a future date after a number of years.

- ✓ **Perpetual Annuity:** If the payment of the annuity continues for an indefinite period. Though annuity means annual payment, the amount of annuity may be paid by 12 monthly instalments, quarterly or half-yearly instalments.

**10. Sinking fund**

It is an amount which has to set aside at fixed intervals of time (say annually) out of the gross income so that at the end of the useful life of the building or the property, the fund accumulated should be equal to the initial cost of the property. The sinking fund may also be required for payment of the loans.

$$\text{Sinking fund } I = \frac{Si}{(1+i)^n - 1}$$

Where, S = Total amount of sinking fund to be accumulated,

n = useful life of the property or nos. of years required to accumulate the sinking fund,

i= rate of interest in decimals and

I = is the annual installments paid.

**Example:** A pumping set with motor has been installed in a building at a cost of 2500.00. Assuming the life of the pump as 15 years, find the annual installment of

sinking fund required to be deposited to accumulate the whole amount of 4% compound interest.

Annual sinking fund $$I = \frac{Si}{(1+i)^n - 1}$$

$$I = \frac{2500\ K\ .040}{(1+0.40)^{15} - 1}$$

$$I = \text{Rs. } 125.00$$

## Factors Affecting Value of a Building

- ✓ Type of the building
- ✓ Location
- ✓ Building structure and durability
- ✓ The quality of materials used in the construction
- ✓ Size of the building

## Depreciation

It is the loss in value of a building or property due to structural deterioration, wear and tear, decay and obsolescence. It depends on use, age, nature of maintenance etc. A certain percentage (per annum) of the total cost may be allowed as depreciation to determine its present value.

The percentage rate of depreciation is less at the beginning and increases with age. Annual depreciation is the annual decrease in the value of the property.

## Comparison Between Depreciation and Obsolescence

| Depreciation | Obsolescence |
|---|---|

| | |
|---|---|
| This is the physical loss I the value of the property due to wear & tear, decay etc. | This is the loss in the value of the property due to the change in design, fashion, in structure of the other, change of utility and demand. |
| Depreciation depends on its original condition, quality of maintenance and mode of use | Obsolesce depends on normal progress in the arts, inadequacy to present or growing needs etc. |
| This is variable according to age of the property. More is the age, more will be the amount for depreciation | This is not dependent on age of the building. A new building may suffer in its usual rent due to obsolescence. |
| There are different methods by which the amount of depreciation can be calculated | At present there is no method of calculation of obsolescence |

## Calculation of Depreciation

The amount of depreciation being known, the present value of the property can be calculated after deducting the total amount of depreciation from the original cost.

- Straight line method
- Constant percentage method
- Sinking fund method
- Quantity survey method

**1. Straight line method**

It is assumed that the property loses its value by the same amount every year. A fixed amount is deducted every year, so that at the end of the utility period, only the scrap value remains. Therefore, the annual depreciation "D" is estimated as:

$$D = \frac{\text{Original value} - \text{Scrap Value}}{\text{Life in years}}$$

$$D = \frac{C-S}{N}$$

And the book value after „n" years = Original cost – n x D

**2. Constant percentage method (declining balance method)**

It is assumed that the property will lose its value by a constant percentage of its value at the beginning of every year.

**3. Sinking fund method**

It is assumed that the depreciation is equal to the annual sinking fund plus the interest on the fund for the year, which is supposed to be invested on interest bearing investment.

If A is the annual sinking fund and b, c, d etc. represent interest on the sinking fund for subsequent years, then the depreciation at the end of various years can be calculated as:

| **Year** | **Depreciation for the year** | **Total depreciation** | **Book value** |
|---|---|---|---|
| 1st year | A | A | C-A |
| 2nd year | A+b | 2A+b | C-(2A+b) |
| 3rd year | A+c | 3A+b+c | C-(3A+b+c) |

**4. Quantity survey method**

The property is studied in detail and loss in value worked out. Each step is based on some logical reasoning without any fixed percentage of the cost of the property. Only an experienced valuator can work out the amount of depreciation and the present value of the property using this method.

## Determination of Depreciation of a building

After deciding the cost using the previous measures, it is necessary to allow a suitable depreciation on the cost. The following table provides a reasonable depreciation of a building whose life if 80 years and well maintained.

| Age of the building | Depreciation per year | Total depreciation |
|---|---|---|
| 0-5 years | Nil | Nil |
| 5-10 years | @0.50% | 2.50% |
| 10-20 years | @0.75% | 7.50% |
| 20-40 years | @1.00% | 20% |
| 40-80 years | @1.50% | 60% |
| **Total depreciation after 80 years** | | 90% |

## Methods of Valuation of Building.

The valuation of a building is determined by working out its cost of construction at the present day rate and allowing a suitable depreciation.

**Following data are required for valuation of a building**

- Cost of incurred if the building to be constructed in present day
- Age of the building should be determined
- Visual inspection of its present condition
- Future life span should be determined

### 1. Estimation of present day cost

Present day cost may be estimated from the records, Estimates and Bill of Quantities. If the actual cost of construction is known, this may increase or decrease according to the percentage rise or fall in the rate obtained from the PWD Schedule of Rates. Following are the methods to ascertain the present day cost of a building:

**a. Cost by detailed measurement**

Cost of construction may be calculated by preparing the BOQs of various items of works by detailed measurement at site and taking the rate of each item of work as per the current PWD SOR. All the items of work shall be thoroughly scrutinized and their detailed specification ascertained as per original.

**b. Cost by plinth area**

The plinth area of the building is measured and the present day plinth area rate of similar buildings in the locality is studied, and the cost calculated. It is necessary to examine thoroughly the different parts of the building including the foundation, structure, doors & windows, finishes etc.

## 2. Estimation of present day value of the building

Following methods are available to determine value of a building:

**a) Direct comparison method/ Plinth area method:**

It is the simplest form of valuation. The cost of the property is derived from the cost of property sold recently at its neighbourhood. Plinth area cost prevailing in the locality is then worked out. Finally value of the property can be derived from Plinth area cost multiplied by the plinth area of the property. Similarly Cost may be estimated by Cubical content method.

**b. Depreciation rate method:**

After deciding the cost of the building or structure by any one method, described in 11.9.1, it is necessary to allow a suitable depreciation on the cost.

**c. Rental method**

In this method, the net income by way of rent is found out by deducting all outgoings from the gross rent. A suitable rate of interest as prevailing in the market is assumes and the years purchase is calculated. The net income multiplied by Y.P. gives the capitalized value or valuation of the property.

**d) Land and building method**

In this method, the market value of land and the depreciated value of building are determined individually. Then these two values are added to determine the final value of the property.

**e) Development method**

This method of valuation is used for the properties which are undeveloped or under developed. Those properties were brought, developed and then offered for the sale. The valuation in that case would depend on initial investment, development cost and expected profit.

## UNIT – V
## BUDGETING

### Time Value of Money (TVM)

The time value of money (TVM) is the concept that money you have now is worth more than the identical sum in the future due to its potential earning capacity. This core principle of finance holds that provided money can earn interest, any amount of money is worth more the sooner it is received. TVM is also sometimes referred to as present discounted value.

Understanding Time Value of Money (TVM)

The time value of money draws from the idea that rational investors prefer to receive money today rather than the same amount of money in the future because of money's potential to grow in value over a given period of time. For example, money deposited into a savings account earns a certain interest rate and is therefore said to be compounding in value.

### KEY TAKEAWAYS

- Time value of money is based on the idea that people would rather have money today than in the future.
- Given that money can earn compound interest, it is more valuable in the present rather than the future.
- The formula for computing time value of money considers the payment now, the future value, the interest rate, and the time frame.
- The number of compounding periods during each time frame is an important determinant in the time value of money formula as well.

### Time Value of Money Formula

Depending on the exact situation in question, the time value of money formula may change slightly. For example, in the case of annuity or perpetuity payments, the generalized formula has additional or less factors. But in general, the most fundamental TVM formula takes into account the following variables:

- FV = Future value of money
- PV = Present value of money
- i = interest rate

- n = number of compounding periods per year
- t = number of years

Based on these variables, the formula for TVM is:

$$FV = PV \times [\, 1 + (i / n) \,]^{(n \times t)}$$

## Present Value and Future Value

It is the money you have currently that is equal to a future one-time disbursal or several part-payments – discounted by a suitable rate of interest.

Future Value is the sum of money that any saving scheme with a compounded interest will build to by a pre-decided future date. It applies to both lump sum as well as recurring investments like SIP.

## Capital Investment

Capital investment is a sum of money provided to a company to further its business objectives. The term also can refer to a company's acquisition of long-term assets such as real estate, manufacturing plants, and machinery

***Key Takeaways***

- *A capital investment can be defined as a sum of cash acquired by a company to pursue its objectives.*
- *It also can refer to a company's acquisition of permanent assets.*
- *In the latter case, the company is making an investment in its own future.*

## Types of Business

There are three major types of businesses:

**1. Service Business**

A service type of business provides intangible products *(products with no physical form)*. Service type firms offer professional skills, expertise, advice, and other similar products.

Examples of service businesses are: salons, repair shops, schools, banks, accounting firms, and law firms.

**2. Merchandising Business**

This type of business buys products at wholesale price and sells the same at retail price. They are known as "buy and sell" businesses. They make profit by selling the products at prices higher than their purchase costs.

A merchandising business sells a product without changing its form. Examples are: grocery stores, convenience stores, distributors, and other resellers.

**3. Manufacturing Business**

Unlike a merchandising business, a manufacturing business buys products with the intention of using them as materials in making a new product. Thus, there is a transformation of the products purchased.

A manufacturing business combines *raw materials, labor, and overhead costs* in its production process. The manufactured goods will then be sold to customers.

**4. Hybrid Business**

Hybrid businesses are companies that may be classified in more than one type of business. A restaurant, for example, combines ingredients in making a fine meal (manufacturing), sells a cold bottle of wine (merchandising), and fills customer orders (service).

## Forms of Business Organization

These are the basic forms of business ownership:

**1. Sole Proprietorship**

A sole proprietorship is a business owned by only one person. It is easy to set-up and is the least costly among all forms of ownership. The owner faces *unlimited liability*; meaning, the creditors of the business may go after the personal assets of the owner if the business cannot pay them.

The sole proprietorship form is usually adopted by small business entities.

**2. Partnership**

A partnership is a business owned by two or more persons who contribute resources into the entity. The partners divide the profits of the business among themselves.

In *general partnerships,* all partners have unlimited liability. In *limited partnerships,* creditors cannot go after the personal assets of the limited partners.

**3. Corporation**

A corporation is a business organization that has a separate legal personality from its owners. Ownership in a stock corporation is represented by *shares of stock*.

The owners (stockholders) enjoy limited liability but have limited involvement in the company's operations. The *board of directors*, an elected group from the stockholders, controls the activities of the corporation.

In addition to those basic forms of business ownership, these are some other types of organizations that are common today:

**4. Limited Liability Company**

Limited liability companies (LLCs) in the USA, are hybrid forms of business that have characteristics of both a corporation and a partnership. An LLC is not incorporated; hence, it is not considered a corporation. But, the owners enjoy limited liability like in a corporation. An LLC may elect to be taxed as a sole proprietorship, a partnership, or a corporation.

**5. Cooperative**

A cooperative is a business organization owned by a group of individuals and is operated for their mutual benefit. The persons making up the group are called *members*. Cooperatives may be incorporated or unincorporated.

Some examples of cooperatives are: water and electricity (utility) cooperatives, cooperative banking, credit unions, and housing cooperatives.

## BUDGET AND BUDGETARY CONTROL

The term „Budget" appears to have been derived from the French word „baguette" which means „little bag' , or a container of documents and accounts. A budget is an accounting plan. It is a formal plan of action expressed in monetary terms. It could be seen as a statement of expected income and expenses under certain anticipated operating conditions. It is a quantified plan for future activities – quantitative blue print for action.

Every organization achieves its purposes by coordinating different activities. For the execution of goals efficient planning of these activities is very important and that is why the management has a crucial role to play in drawing out the plans for its business. Various activities within a company should be synchronized by the preparation of plans of actions for future periods. These comprehensive plans are usually referred to as budgets. Budgeting is a management device used for short-term planning and control. It is not just accounting exercise.

## Meaning and Definition:

### Budget:

According to CIMA (Chartered Institute of Management Accountants) UK, a budget is "A plan quantified in monetary terms prepared and approved prior to a defined period of time, usually showing planned income to be generated and, expenditure to be incurred during the period and the capital to be employed to attain a given objective." In a view of Keller &Ferrara, "a budget is a plan of action to achieve stated objectives based on predetermined series of related assumptions."

G.A.Welsh states, "a budget is a written plan covering projected activities of a firm for a definite time period."

One can elicit the explicit characteristics of budget after observing the above definitions. They are...

- It is mainly a forecasting and controlling device.
- It is prepared in advance before the actual operation of the company or project.
- It is in connection with a definite future period.
- Before implementation, it is to be approved by the management.
- It also shows capital to be employed during the period.

## Budgetary Control:

Budgetary Control is a method of managing costs through preparation of budgets. Budgeting is thus only a part of the budgetary control. According to CIMA, "Budgetary control is the establishment of budgets relating to the responsibilities of executives of a policy and the continuous comparison of the actual with the budgeted results, either to secure by individual action, the objective of the policy or to provide a basis for its revision."

The main features of budgetary control are:

- Establishment of budgets for each purpose of the business.

- Revision of budget in view of changes in conditions.
- Comparison of actual performances with the budget on a continuous basis.

- Taking suitable remedial action, wherever necessary.

- Analysis of variations of actual performance from that of the budgeted performance to know the reasons.

## Objectives of Budgetary Control:

Budgeting is a forward planning. It serves basically as a tool for management control; it is rather a pivot of any effective scheme of control.

G. A. Welsch in his book, 'Budgeting - Profit Planning and Control' has rightly pointed out that 'Budgeting is the principal tool of planning and control offered to management by accounting function.' The objectives of budgeting may be summarized as follows:

### 1) Planning:

Planning has been defined as the design of a desired future position for an entity and it rests on the belief that the future position can be attained by uninterrupted management action. Detailed plans relating to production, sales, raw-material requirements, labour needs, capital additions, etc. are drawn out. By planning many problems estimated long before they arise and solution can be thought of through careful study. In short, budgeting forces the management to think ahead, to foresee and prepare for the anticipated conditions. Planning is a constant process since it requires constant revision with changing conditions.

### 2) Co-ordination:

Budgeting plays a significant role in establishing and maintaining coordination. Budgeting assists managers in coordinating their efforts so that problems of the business are solved in harmony with the objectives of its divisions.

Efficient planning and business contribute a lot in achieving the targets. Lack of co-ordination in an organization is observed when a department head is permitted to enlarge the department on the specific needs of that department only, although such development may negatively affect other departments and alter their performances. Thus, co-ordination is required at all vertical as well as horizontal levels.

**3) Measurement of Success:**

Budgets present a useful means of informing managers how well they are performing in meeting targets they have previously helped to set. In many companies, there is a practice of rewarding employees on the basis of their accomplished low budget targets or promotion of a manager is linked to his budget success record. Success is determined by comparing the past performance witha previous period's performance.

**4) Motivation:**

Budget is always considered a useful tool for encouraging managers to complete things in line with the business objectives. If individuals have intensely participated in the preparation of budgets, it acts as a strong motivating force to achieve the goals.

**5) Communication:**

A budget serves as a means of communicating information within a firm. The standard budget copies are distributed to all management people that provides not only sufficient understanding and knowledge of the programs and guidelines to be followed but also gives knowledge about the restrictions to be adhered to. 6) Control: Control is essential to make sure that plans and objectives laid down in the budget are being achieved. Control, when applied to budgeting, as a systematized effort is to keep the management informed of whether planned performance is being achieved or not.

## Advantages of Budgetary control:

In the light of above discussion one can see that, coordination and control help the planning. These are the advantages of budgetary control.

But this tool offer many other advantages as follows:

1. This system provides basic policies for initiatives.

2. It enables the management to perform business in the most professional manner because budgets are prepared to get the optimum use of resources and the objectives framed.

3. It ensures team work and thus encourages the spirit of support and mutual understanding among the staff.

4. It increases production efficiency, eliminates waste and controls the costs.

5. It shows to the management where action is needed to remedy a position.

6. Budgeting also aids in obtaining bank credit.

7. It reviews the present situation and pinpoints the changes which are necessary.

8. With its help, tasks such as like planning, coordination and control happen effectively and efficiently.

9. It involves an advance planning which is looked upon with support by many credit agencies as a marker of sound management.

## Limitations of Budgetary control:

1. It tends to bring about rigidity in operation, which is harmful. As budget estimates are quantitative expression of all relevant data, there is a tendency to attach some sort of rigidity or finality to them.

2. It being expensive is beyond the capacity of small undertakings. The mechanism of budgeting system is a detailed process involving too much time and costs.

3. Budgeting cannot take the position of management but it is only an instrument of management. „The budget should be considered not as a master, but as a servant."

It is totally misconception to think that the introduction of budgeting alone is enough to ensure success and to security of future profits.

4. It sometimes leads to produce conflicts among the managers as each of them tries to take credit to achieve the budget targets.

5. Simple preparation of budget will not ensure its proper implementation. If it is not implemented properly, it may lower morale.

6. The installation and function of a budgetary control system is a costly affair as it requires employing the specialized staff and involves other expenditure which small companies may find difficult to incur.

## The steps in preparing a budget

Many organizations prepare budgets that they use as a method of comparison when evaluating their actual results over the next year. The process of preparing a budget should be highly regimented and follow a set schedule, so that the completed budget is ready for use by the beginning of the next fiscal year. Here are the basic steps to follow when preparing a budget:

1. ***Update budget assumptions.*** Review the assumptions about the company's business environment that were used as the basis for the last budget, and update as necessary.
2. ***Review bottlenecks***. Determine the capacity level of the primary bottleneck that is constraining the company from generating further sales, and define how this will impact any additional company revenue growth.
3. ***Available funding.*** Determine the most likely amount of funding that will be available during the budget period, which may limit growth plans.
4. ***Step costing points.*** Determine whether any step costs will be incurred during the likely range of business activity in the upcoming budget period, and define the amount of these costs and at what activity levels they will be incurred.
5. ***Create budget package.*** Copy forward the basic budgeting instructions from the instruction packet used in the preceding year. Update it by including the year-to-date actual expenses incurred in the current year, and also annualize this information for the full current year. Add a commentary to the packet,

stating step costing information, bottlenecks, and expected funding limitations for the upcoming budget year.

6. ***Issue budget package.*** Issue the budget package personally, where possible, and answer any questions from recipients. Also state the due date for the first draft of the budget package.
7. ***Obtain revenue forecast.*** Obtain the revenue forecast from the sales manager, validate it with the CEO, and then distribute it to the other department managers. They use the revenue information as the basis for developing their own budgets.
8. ***Obtain department budgets.*** Obtain the budgets from all departments, check for errors, and compare to the bottleneck, funding, and step costing constraints. Adjust the budgets as necessary.
9. ***Obtain capital budget requests.*** Validate all capital budget requests and forward them to the senior management team with comments and recommendations.
10. ***Update the budget model.*** Input all budget information into the master budget model.
11. ***Review the budget.*** Meet with the senior management team to review the budget. Highlight possible constraint issues, and any limitations caused by funding problems. Note all comments made by the management team, and forward this information back to the budget originators, with requests to modify their budgets.
12. ***Process budget iterations.*** Track outstanding budget change requests, and update the budget model with new iterations as they arrive.
13. ***Issue the budget.*** Create a bound version of the budget and distribute it to all authorized recipients.
14. ***Load the budget***. Load the budget information into the financial software, so that you can generate budget versus actual reports.

## UNIT 1

**PART-A (2 marks)**

1. State the importance of specification.
2. Describe the prominent aspects of design of specification.
3. State the necessity of specification.
4. What is the significance of specification?
5. What is the purpose of specification?
6. How do you write specification?
7. Discuss the significance of specification writing.
8. What is the purpose of writing brief specification?
9. State why specification is essential in construction.
10. State the specification for 2nd class brick work.
11. Write the specification of ceramic tiles for flooring.
12. Write the specification for 1st class brick work.
13. What is the specification for Damp proof course.
14. Write the specification for earth work.
15. Write the specification for plastering.
16. What sources are considered as guidelines for writing specifications in India?

**PART-B (16 marks)**

1. Elucidate in detail the principles of specification writing and classification of specification.
2. Give an account on types of specification and principles of specification writing.
3. Discuss in detail the important aspects of the design of specification and sources of information.
4. What are the types of specifications? Highlight their significance and illustrate with an example, the significant aspects to be covered while writing specification.
5. Illustrate the general specification with units for the following works:

    1. Earth work excavation
    2. Painting the outer walls
    3. Wood works for fully paneled doors.

6. Give a detailed specification for Reinforced cement concrete work.

7. Chart out a detailed specification for Damp proof course and dado work for marble flooring.

8. Elucidate in detail the specification for earthwork and plain cement concrete.

9. Illustrate the specification for cement plastering for brick walls and weather proofing course in terrace.

10. Explain in detail the brief specification for I class and II class building.

11. Write detailed specification for first class brick work in 1:6 cement mortar.

12. Write detailed specification for reinforced cement concrete slab.

## UNIT 2

**PART-A (2 marks)**

1. Briefly explain the various factors to be considered during preparation of a detailed estimate.

2. "To finalize the rate of an item, the analysis of rates is must". Justify the statement.

3. What are the requirements for preparing estimation.

4. Write the significance of approximate estimation.

5. Brief the method of calculation of materials for brickwork for walls.

6. State the purpose of detailed estimate.

7. What are contingency charges?

8. What do you understand by optimization of resources?

9. Outline any two methods of Quantity Estimation.

10. Write a short account on necessity of estimation.

11. State the significance of principles of measurement and billing.

12. Give the details of estimation for lime concrete. Assume necessary data.

**PART-B (16 marks)**

1. Elaborate in detail the types of estimate of buildings and requirements for preparing estimation.
2. Describe the principles of measurement and billing contingencies. State the measurement of brick work.
3. Explain in detail the method of deriving detailed quantity of estimate for Cement Plastering and iron works.
4. Chart out the general guidelines for preparing detailed estimate by using long wall and short wall method.(Assume necessary data)
5. Chart out in detail the method of estimation for a framed RCC building.
6. Explain in detail the difference between center line method and long wall and short wall method for estimation.
7. Make a detailed estimation for painting and flooring.
8. Write short notes on:

   (i) Bill of quantity

   (ii) Contingencies

   (iii) Requirements for preparing an estimate.
9. Discuss in detail the various types of estimate.
10. Discuss the various factors responsible for determining the rate of an item of work.