MODULE – 3

"SPECIFICATION AND ANALYSIS OF RATES"

SPECIFICATIONS

Specifications describe the nature and the class of the work, materials to be used in the work, workmanship etc. and is very important for the execution of the work. The cost of a work depends much on the specifications. Specifications should be clear.

Purpose of giving Specifications

- The cost of an unit quantity of work is governed by its specifications.
- Specification of a work is required to describe the quality and quantity of different materials required for a construction work and is one of the essential contract documents.
- This also specifies the workmanship and the method of doing the work. Thus specification of a work serves as a guide to a supervising staff of a contractor as well as to the owner to execute the work to their satisfaction.
- 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.
- As the rate of work is based on the specification, a contractor can calculate the rates of various items of works in tender with his procurement rates of materials and labour. Thus tender rate without specification of works is baseless, incomplete and invalid.
- Specification is necessary to specify the equipment tools and plants to be engaged for a work and thus enables to procure them beforehand.
- The necessity of specification is to verify and check the strength of materials for a work involved in a project.

Types of Specifications

1. General Specifications
2. Detailed Specifications

General Specifications

In general specifications, nature and class of works and names of materials that should be used are described. Only a brief description of each and every item is given. It is useful for estimating the project. The general specifications do not form a part of contract document.

Detailed Specifications

The detailed specifications form a part of a contract document. They specify the qualities, quantities and proportions of materials and the method of preparation and execution for a particular item of works in a project. The detailed specifications of the different items of the work are prepared separately and they describe what the work should be and how they shall be executed. While writing the detailed specifications, the same order sequence as the work is to be carried out is to be maintained.

RCC Specifications

Shuttering shall be done using seasoned wooden boards of thickness not less than 30mm.

- Surface contact with concrete shall be free from adhering grout, nails, splits and other defects.
- All the joints are perfectly closed and lined up.
- The shuttering and framing is sufficiently braced.
- Nowadays timber shuttering is replaced by steel plates.
- All the props of approved sizes are supported on double wedges and when taken out, these wedges are eased and not knocked out.
- All the framework is removed after 21 days of curing without any shocks or vibrations.
- All reinforcement bars conform IS specifications and are free from rust, grease oil etc.
- The steel grills are perfectly as per detailed specifications.
- The covers to concrete are perfectly maintained as per code.
- Bars of diameter beyond 25mm diameter are bent when red hot.
- The materials proportion should be as per the specifications of the concrete.

Number of Cement bags required for a specific cement concrete ratios

- For cement concrete of ratio 1:1:2(1 cement:1sand/coarse sand:2graded stone aggregate) require 11no bags of 50kg.
- For cement concrete of ratio 1:1.5:3 require 7.8no bags of 50kg.
- For cement concrete of ratio 1:2:4 require 6 no bags of 50kg.
- For cement concrete of ratio 1:3:6 require 4.25no bags of 50kg.
- For cement concrete of ratio 1:4:8 require 3.2 no bags of 50kg.
- For cement concrete of ratio 1:5:10 require 2.50 no bags of 50kg.
- For cement concrete of ratio 1:6:12 require 2.25 no bags of 50kg.

Brick Masonry with Cement Mortar

Masonry is the building of structures from individual units laid in and bound together by mortar; the term *masonry* can also refer to the units themselves. The common materials of masonry construction are brick, stone such as marble, granite, travertine, limestone, concrete block, glass block and tile. Masonry is generally a highly durable form of construction. Brick masonry construction involves use of high quality materials in construction. Use of low grade materials in construction or mortar mix in inappropriate ratio can affect the quality of construction.

Specifications for Brick masonry in Cement Mortar

- The bricks shall be of first class, regular in shape, size and colour.
- The bricks should be free from flaws, cracks and lumps of any kind.
- Shall have minimum crushing strength 10.5N/mm2.
- The bricks shall not absorb the water more than one sixth of the weight of the brick.
- The sand used shall be medium coarse, clean, sharp, free from clay, mica and other organic matter.
- The cement used shall satisfy the requirement of Bureau of Indian Standard.
- The mortar is designated in specified proportion of cement and sand. The materials are weighed or measured and mixed on watertight platform after allowing bulkage of sand.
- Bricks before laying shall be thoroughly soaked in water.
- The bricks laid truly horizontal in course with frogs upwards.
- The brickwork shall be raised 1m in height at a strength all round the building.
- Only fresh mortar within ½ hour for cement mortar, the time of adding water shall be used.
- During rains, no brickwork is carried out when special arrangements are made.
- The brickwork shall be kept wet for atleast 10 days.

Coursed Rubble Masonry

- Masonry is affected by the use of low grade materials that is in case of stone masonry, use of low grade stones, improperly cut stones, chipped off stones etc. The mortar mix should follow a specific standard for the proper bonding between the joints of Course Rubble Masonry. Therefore, specifications have to be given for the materials used, the laying technique, Bond or Through stones, Quoins and curing – for the ultimate strengthening of the final masonry work.

Specifications for Coursed Rubble Stone (CRS) Masonry

Material Specifications

- Stone shall be hard, sound, free from decay and weathering. Stones with porous matter or with boulder skin shall be rejected. The size of stones shall not be less than 15cm in any direction.
- Cement and sand for cement mortar or lime and surkhi for lime mortar shall be of standard specification.

Laying Technique specified

- All the stones shall be thoroughly wetted before laying. Every course of stone shall be hammer dressed and laid truly horizontal and every vertical joint shall be truly vertical. Faces shall be accurately squared and each face joint shall be dressed at right angles. The face stones shall be laid in alternate headers and stretchers fashion. The masonry shall shall be carried up regularly and true to plumb. The thickness of joints shall not exceed 12mm.

Bond or through stones

- The stones going through in the walls shall be well distributed by arranging them in a staggered fashion in successive courses. The intervals of through stones shall not be less than 1.5m in each course. For walls upto 60cm thickness, a through stone shall extend from one face of the wall to the other.

Laying of Quoins

- Corner stones or quoins shall be dressed to correct angle. The short bed of the stone shall be at least equal to height. The quoins shall be laid with header and stretcher in alternate layers.

Curing Method

- The work shall be protected from rain or sun while it is green. At the end of the day's work, the top surface of the walls shall be kept flooded so that it acquires the required strength. The masonry shall be kept moist on all the faces for at least 7 days.

Plain Cement Concrete (PCC) is a construction material generally used as a binding materials and is composed of cement, (commonly Portland Cement) and other cementitious materials such as fly ash and slag cement, aggregate (generally a coarse aggregate made of

gravels or crushed rocks such as limestone or granite, plus a fine aggregate such as sand), water, and chemical admixtures.

Specifications for Plain Cement Concrete (PCC)

Materials Specifications

- **Aggregate** shall be of invert materials and should be clean, dense, hard, sound, durable, non-absorbent and capable of developing good bond with mortar.
- **Coarse aggregate** shall be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matters. The stone ballast shall be of 20mm size and smaller. All the coarse material should be retained in a 5mm square mesh and should be well graded such that the voids do not exceed 42%.
- **Fine aggregate** shall be of coarse sand consisting of hard, sharp and angular grains and shall pass through a screen of 5mm square mesh. Sand shall be of standard specifications, clean and free from dust, dirt and organic matter. Sea sand shall not be used.
- **Cement shall be fresh Portland cement of standard ISI specifications** and shall have the required tensile and compressive stresses and fineness.
- **Water** shall be clean and free from alkaline and acid matters and suitable for drinking purposes.
- **Proportion Specifications**

  1:2:4 (cement : sand : stone ballast) by volume when specified. Minimum compressive strength of concrete of 1:2:4 proportion shall be 140 kg/cm2 in 7 days.
- **Hand mixing**

  Mixing shall be done on masonry platform or sheet iron tray.
- **Machine mixing**

  Stone ballast, sand and cement shall be put into cement concrete mixer to have the required proportions.
- **Slump**

  Regular slump test should be carried out to control the addition of water and to maintain the required consistency. A slump of 7.5cm to 10cm may be allowed for building work.
- **Formwork**

Formwork centering and shuttering shall be provided as required as per the standard specification before laying concrete to confine to support or to keep the concrete in position. The inner surface of shuttering shall be oiled to prevent concrete sticking to it.

- **Laying Technique**

  Concrete shall be laid gently (not thrown) in layers not exceeding 15cm and compacted by pinning with rods and tamping with wooden tampers or with mechanical vibrating machine until a dense concrete is obtained.

- **Curing Method**

  After about two hours of laying of concrete, when the concrete has begun to harden, it shall be kept damp by covering with wet gunny bags or wet sand for 24 hours.

ANALYSIS OF RATES

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

The rate of particular item of work depends on the following:

1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity of materials and their costs.
3. Cost of labours and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

Cost of materials at source and at site of construction:

The costs of materials are taken as delivered at site inclusive of the transport local taxes and other charges.

Purpose of Analysis of rates:

Purpose of Analysis of rates:

1. To work out the actual cost of per unit of the items.
2. To work out the economical use of materials and processes in completing the particulars item.

3. To work out the cost of extra items which are not provided in the contract bond, but are to be done as per the directions of the department.

4. To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

Cost of labour -types of labour, standard schedule of rates:

The labour can be classified in to

1) Skilled – 1st class

2) Skilled – 2d Class

3) Unskilled

The labour charges can be obtained from the standard schedule of rates 30% of the skilled labour provided in the data may be taken as Ist class, remaining 70% as II class.

The rates of materials for Government works are fixed by the superintendent Engineer for his circle every year and approved by the Board of Chief Engineers. These rates are incorporated in the standard schedule of rates.

Lead statement: The distance between the source of availability of material and construction site is known as "Lead " and is expected in Km. The cost of conveyance of material depends on lead.

Rate Analysis:

Every construction project is divided into number of activities. Each activity consists of different types of civil or construction works.

For example, the in the construction of a building, the activities can be excavation or earthwork, Concrete work, masonry work, Wood work such as doors and windows, plumbing, flooring, waterproofing, finishing work such as plastering, painting and distempering.

The Activity earthwork can be divided into many types based on depth and type of soil. For example, an excavation of 1.5m deep in soft soil, an excavation of 3m deep in hard soil. Likewise, concrete work can be divided into many types based on its mix proportions and its placement.

For example, M25 reinforced concrete work in foundation, M30 reinforced concrete work in columns, slabs etc. Likewise, there can be many small civil works in every construction project.

The cost of any construction project is calculated based on each works associated with every construction activity. Thus it is essential to calculate cost of each small works.

Rate analysis of Civil Works or Building Works is the determination of cost of each construction work per unit quantity. This cost includes the cost of materials, labours, machinery, contractors profit and other miscellaneous petty expenses required for the particular work to be complete in unit quantity.

For example, cost of 1 cubic meter of M20 RCC work in slab, Cost of 1 cubic meter of excavation in soft soil of 1.5m depth, cost of 1 square meter of plastering of 20mm, cost of 1 square meter of painting work with specified paint in 2 layers or 3 layers as required.

The cost of materials in rate analysis is calculated as combination of cost of material at origin, its transportation costs, taxes. The rate of labour is based on skill of the labour, such as skilled labour, semi-skilled and unskilled labour. The cost of materials and labours vary from place to place. Thus, the cost of each construction work varies from place to place.

What are the Factors Affecting Analysis of Rates of Civil Works?

Factors which affect the rate analysis of civil works are:

- Specification of the civil work and materials such as quality of materials, proportion of mortar or concrete, thickness of plastering, number of coats of painting, depth of excavation, type of soil etc.
- Location of the construction site – Distance of construction site from source of materials, availability of labours, availability of water, machinery etc. influence the rate analysis of construction work.
- Quantity of materials, number of different types of labours and rates of materials and labours influence the rate analysis.
- Profit of the contractor, miscellaneous expenses and other overheads also influence the rate analysis.

Types of Construction Project Costs – Direct and Indirect Costs

Any construction project consists of direct and indirect costs which forms the total costs and expenses resulting from the use of principal components for implementing construction projects. Different classification of construction project costs and their features are explained below.

Types of Construction Project Costs

Before moving into the main classification of project costs, some of the specific costs encountered in construction projects are explained below.

1. Fixed Cost

This is defined as the cost spent once for a particular point of time. The purchase of equipment, machinery etc comes under fixed cost assets.

2. Time-Related Cost

Time-related cost is the cost spend for a particular activity for a given duration. The cost spent on wages, equipment and building rents etc comes under this category.

3. Quantity -Proportional Cost

This type of cost will vary based on the quantities. Materials costs are examples of quantity-proportional costs.

Major classification of construction projects costs are:

1. Project direct costs
2. Project Indirect Costs

Total Project Cost = Project Direct Costs + Project Indirect Costs

Direct Costs of Construction Project

The costs and expenses that are accountable directly on a facility, function or product are called as direct costs. In construction projects, the direct costs are the cost incurred on labor, material, equipment etc.

These costs for a construction project are developed as estimates by means of detailed analysis of the contract activities, construction method, the site conditions, and resources.

Different direct costs in construction projects are material costs, labor costs, subcontractor costs, and equipment costs.

Indirect Costs of Construction Project

The costs, unlike direct costs, is not directly accountable for a particular facility, product or function. Indirect costs can be either variable or fixed.

The main sections coming under indirect costs are personnel costs, security costs, and administration costs. These costs do not have a direct connection with the construction project.

The indirect cost can be classified as:

1. Project Overhead Costs

In a construction project, the cost of some of the items cannot be directly allocated for a specific activity. Most of the site related costs come under this section and are categorized as project overhead costs.

Project overhead costs can either be fixed or time-related costs. Different costs coming under overhead costs are the costs of stores, safety facilities, workshops, offices, staffs and parking facilities. All those plants that are required to support the working crews will come under this cost.

The overhead cost is estimated by a detailed analysis of the site-related activities and their cost. Hence an accurate cost estimate is obtained. Most of the companies make use of forms and checklist developed by them to estimate these costs. The site overhead costs account for 5 to 15% of the total project costs.

2. General Overhead Costs

The general overhead costs cannot be directly charged for a specific project. These form the costs that are used to support the overall activities of the company. The general overhead costs will include the cost of the design engineers, expenses of head-office, cost of directors and managers, schedulers etc.

The general overhead expense and cost are found reasonable through continuous monitoring of the company expenses. The general overhead costs account for 2 to 5 % of the contract direct costs.

The amount of the general overhead that should be allocated to a specific project equals:

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

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

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

a) Quantity of cement required $= \frac{1}{(1+2+4)} \times 1.52 \times 20 = 4.14m^3 \times \frac{1440}{50}$

$= 119.26$ bags

Quantity of Sand required $= \frac{2}{(1+2+4)} \times 1.52x20 = 8.28m^3$

Quantity of cource aggreate $= \frac{4}{7} x1.52x20 = 16.56m^3$

b) Quantity of cement required $= \frac{1}{10} \times 1.52 \times 1.5 = 2.28m^3 \times \frac{1440}{50} =$ ~~65.66~~ Bags

Quantity of sand required $= \frac{3}{10} \times 1.52x\ 15 = 6.84m^3$

Quantity of CA required $= \frac{6}{10} \times 1.52x15 = 13.68m^3$

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

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

b) CM (1:6) for $1m^3$ of work

Hint: Cement will go to fill up the volds in sand. So total volume was be 4 instead of 1+4=5

a) Quantity of Cement required $= \frac{1}{4} \times 1 = 0.25m^3 = 0.25 \times \frac{1440}{50} = 7.2$ bags

Quantity of Sand required $= \frac{4}{4} \times 1 = 1m^3$

b) Quantity of cement required $= \frac{1}{6} \times 1 = 0.16m^3 = 0.16 \times \frac{1440}{50} = 4.8$bags

Quantity of sand required $= \frac{6}{6} \times 1 = 1m^3$

Example 3:-Calculate the Quantity of Cement required in bags for the following items.

a) B.M. in CM(1:3) for 15 cum of work using $0.2m^3$ of CM required for $1m^3$ of Brick work

b) RCC (1:2:4) for $20m^3$ of work

Sol : a) $1m^3$ of Brick work - $0.2m^3$ of CM(1:3)

$15\ m^3$ of Brick work $= 15 \times 0.2 = 3m^3$

Quantity of cement required in bags $= \frac{1}{3} \times 3 \times \frac{1440}{50} = 28.8$bags

b) Quantity of Cement required in bags $= \frac{1}{7} \times 1.52 \times 20 \times \frac{1440}{50} = 125$ bags