



UNIT-2

Cost Estimation in Construction Industry

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Explain the components of estimates
- ✓ Explore different methods for estimation.
- ✓ Discuss the importance of estimation in Construction Projects.

Unit 2

Most construction projects require that you determine the approximate quantities of resources to accomplish project objectives. This preliminary determination of the quantities of resources required is known as the 'construction estimate'. Resources, which are needed, include labour, equipment, time, and construction materials. The process of estimating these resources is tied to money, so construction estimates usually require computing how much money is needed to execute the project from start to finish. All parties involved in the project are keen to learn about the estimates at various phases of the project. All estimates should be as close to the true value as possible.

In this unit, we will make presentation on the different components of estimating construction projects, including how to perform cost estimations at each phase of the construction project.

Estimate of a Construction Project

Purpose of an Estimate

Owner

- i) To provide necessary funds
- ii) To compare the offers given by tenders and select the best contractor at the lowest price

Contractor

- iii) Enable consultant earn a reasonable profit
- iv) Enable him to organise all necessary resources to complete the project

Consultant

- v) The estimates enable him to calculate the appropriate fees to charge the client
- vi) Assist the client in selecting contractors

Components of an Estimate

Construction projects involve numerous activities, which then consumes resources. These resources which cost money form the basis of estimating the cost of building a structure. There are other related costs incurred before the actual project takes off as well as after the project has been completed -these must also be considered. Estimates can be determined for each of the phases during the life time of the project. Below, we discuss how these can be done.

Estimation during Feasibility Studies

Feasibility studies include technical and financial dimensions. These have to be undertaken and approved before the actual project is executed. Technical feasibility studies involve detailed examination of factors such as building technology, design methods and materials that would make construction possible. Financial feasibility studies on the other hand are carried out to determine the profitability of the investment being made in the project.

Feasibility studies are important tools that help to obtain answers to the following crucial questions:

- Are the costs reasonable or too excessive?

- What economic alternatives are available to choose from?
- If alternatives exist, which one is more economical to pursue in terms of materials and layout, etc.?
- What is the overall cost of the project?

Construction cost estimates are useful for finding the answers to the question posed above and are also known as feasibility estimates. Feasibility estimates are usually performed at the early stage of the project within a short period. As a result, they are aptly referred to as approximate estimates because they are not useful during the actual execution of the project.

Quick Method of Approximate Estimate

Two main steps are required to quickly estimate the approximate cost of new structures:

- The first step involves finding the total units for constructing the structure based on the physical dimensions such as the area, volume or length
- Next, multiply the figure obtained in step 1 by the cost of structure per unit

Cost Data

Site supervisors need to keep records on total cost of materials and other resources used for executing a project to enable the cost estimator to produce accurate and reliable unit rate for computing the approximate estimate. The benefit of such records is that they could be used in the future to produce approximate estimate of the cost of similar projects. In order to do so, the estimator must, however, take note of the following when estimating new project cost using previous data:

- Take note of any price variation since the project was completed and include this in the new calculation
- Take note of differences in new product due to site location, design methods, construction methods, type of materials, labour, equipment etc.

How reliable an approximate estimate turns out depends on the following factors:

- Accuracy of recorded cost data
- Price adjustment based on new information on the new structure

Estimation during Project Report Stage and for Project Approval

Execution Strategy

When a project is found to be feasible for execution, the next step taken is the writing of a project report detailing important details which will be useful in the execution of the project. These include:

- i) Layout of the project
- ii) Design and drawings
- iii) Technical specifications
- iv) Estimates of cost

The project report and the cost estimates may also be used to solicit the approval of qualified authorities who have an interest in the project. The layout of works, design, drawings and technical specifications should have been completed prior to carrying out the estimation for the project report. The owner of the facility must also decide on the execution method at the project report stage as this helps in the correct preparation of estimates. The owner has two choices to make in terms of mode of execution:

- Decide whether the project will be by contract or departmental construction
- If it will be a contract arrangement, then, what type of contract would be the best option to choose?

For jobs, which cannot be easily measured or estimated, provision is made for using lump sum contract.

Estimating Procedure

i) Items and Units

The estimator creates a list of activities that need to be performed with the aid to the drawings and specifications. The list can subsequently be used for the bill of quantities and for tendering and making payment to contractors. Activities that can be undertaken include:

- Lineout
- Excavation

The units of measurement are determined based on length, width, height, area or volume of various components of structures.

ii) Taking off the Dimensions

The items listed above will require a suitable dimension being taken off materials and the drawings done in appropriate units for each item, and allowances made for portions of the items which are not required to be removed before construction starts. For example, allowance may be made for doors and windows and these must be factored in appropriately.

The two procedures described above (the Lineout and Excavation Procedures) should result in a list consisting of items, their quantities and matching units. All items are priced per unit, taking into consideration all resource input cost associated with each item.

Each construction item requires materials, labour, and equipment. This means that it is imperative to create applicable rates for each item.

iii) Materials Rate

The material quality for each item should be known by the estimator based on the exact specifications given. Suppliers usually provide price quotations for the materials. The material rate should also include the following costs in addition to the supplier's quoted price:

- Transport of the material
- Loading and unloading
- Handling on site
- Storing, watch and ward
- Wastage to cover breakage, losses, theft which may vary from 2%-10%

iv) Labour Rate

The labour rate is the most unpredictable plan due to several factors. Factors such as the expertise of the worker and weather effects are difficult to control. The labour rate depends upon the skill and size of labour. The size of labour is influenced by the quantity of items and the output of labour. Since it has been established that labour outputs are uncertain, the best solution requires keeping records of skilled, unskilled and semi-skilled worker time for a period of time. This comprehensive record can help to determine the labour components for each item (i.e. this should be in terms of the number of labour days taken to perform a task).

Calculation can subsequently be made for the cost of labour per head for each day. This includes:

- a) Basic wage primarily governed by the prescribed minimum wages or fair wages
- b) Payment for inclement weather when the labour reports to work but cannot be assigned any work or can do work only for a part of the day due to unfavourable weather or heavy rains
- c) Paid holidays
- d) Expenditure incurred on travel, labour camps
- e) Overtime payment
- f) Sickness benefits
- g) Insurance
- h) Any other payment as per statutory requirement
- i) Conveyance of labour
- j) Items (b) to (i) form a percentage of the basic wage

v) Equipment Rate

The equipment's rate can be calculated using the quantity of item and the output of the equipment. It is performed based on the total hours the equipment can be put to work (equipment hours) or the required unit output expected of each item. The following lists are considered when determining the equipment rate:

- Cost of capital investment
- Depreciation
- Cost of fuel and lubricants
- Repairs and maintenance
- Salaries of operators and helpers
- Allowance for potential idle time
- Insurance
- Any other related expenses

The material rate, labour rate and the equipment rate are used to calculate the unit rate for each of the items and then subsequently, the overall cost of each item. Lump sums are quoted in cases

where the cost of the item cannot be determined by measurement. This is usually obtained using past experience or based on the work content of the item.

The costs that have been determined above collectively make up the cost associated with the actual work. The following costs should also be added:

- a) Expenditure on surveys, data collection, design, drawings, and estimating
- b) Land acquisition
- c) Establishment required during the execution of work
- d) Allowance for unforeseen works that may be found necessary in the course of execution
- e) Overhead expenses, which are meant to be incurred on site, as well as, in the head quarters

The cost of work plus the additional associated cost summed up to give the total cost of the project.

vi) Project Approval

Two types of approval have to be secured for construction projects; the administrative and technical approvals.

a) Administrative Approvals

The administrative approval must be acquired first. The approval is given by a competent authority at the user department. If for example, the health department wants to construct a hospital, it may contact the Public Works Department to carry out feasibility studies, provide layout drawings and specification to enable initial cost estimates to be determined as explained in the previous paragraph. The owner of the project (user department) is provided with the drawings and cost estimates for him/her to give the go ahead when the proposals from the Public Works Department are deemed acceptable. The above process is known as the administrative approval.

b) Technical Sanction

When the user department (owner) gives his approval for the initial drawings and cost estimates, the Public Works Department goes ahead to provide detailed design, drawing and cost estimates. Detailed reports must be approved by a competent person(s) at the Public Works Department.

Estimating for Planning Bill of Quantities

Departmental Construction

The bill of quantity is a document which shows the items, the quantity of items and the unit of measurement. Together with the specification list, they aid planning, scheduling and execution of projects. For projects requiring the departmental approach of execution, the approved estimates can serve as a start up guide. However, these estimates have to be supplemented by detailed working drawings. Other

estimates may be obtained during the execution of the project when the need arises. These estimates have to be approved by the right authority according to sanctioned estimates.

Construction through Contract

Contract type of construction requires the owner to provide a bill of quantities to the contractor and may be used as a basis to obtaining offers from tenderers for each item. The client picks items from sanction estimates to prepare a bill of quantities which is given to the contractor. The contractor who is doing the tendering is required to provide his own rates against the items of the bill of quantities.

It is also expected of the tender provides his own bill of quantities as part of his tender. This bill of quantities can also be used to prepare plans, scheduling, and construction of the project.

Programme of Work

To prepare the contractors bill of quantities, the contractor must do the following:

Study the tender documents critically

- i) Go to the site of work to collect detailed information to help him prepare the bill of quantities
- ii) Prepare a comprehensive construction programme. This programme shows the principal items of construction, the duration required by them and the scheduled dates of their start and completion. Such a programme is of considerable assistance in accurate pricing of material, labour, plant and equipment, scaffolding etc.

Important divisions of the contractor's bill of quantities are as below:

a) The Contractors' Own Work

The contractor identifies portions of the work that he can carry out himself and provides material, labour and equipment rates for each of the items he is going to work on.

b) Work Done by the Sub- Contractor

The main contractor finds suitable sub-contractors to assist in other areas of work on his behalf. The client has to approve this. The sub-contractors enter into a bidding process and the contractor chooses the best proposition from the bidders and then adds his profit margin and other expenses to the winning bid(s). The total cost is added to his bill of quantities.

c) The Nominated Sub- Contractor and/or Supplier

Activities relating to the work done by the main contractor, in conjunction with sub-contractors and suppliers of materials, which are chosen by the owner, have to be considered. Activities, such as, unloading of vehicles, sorting, storing and supervision are priced and added to the contractor's profit margin. These are recorded under provisional sums (prime cost).

d) Insurances

The work has to be adequately insured by the main contractor based on the terms of the contract regarding insurance issues. Insurance is normally taken against risks of injuries, damages, or fires.

General Items

Provision has to be made for the following in addition to items listed above:

- Transport to and from the site; erection and dismantling of large plant and equipment
- Scaffolding
- Setting out works
- Watch and ward
- Providing and maintaining access roads to the site as well as of facilities like offices, stores, canteen, roads, and latrines in the works area
- Lighting and water and power
- Bailing out water
- Telephone facilities
- Expenditure on hospitality

Any other related expenditure. The expenses listed above provide the total cost construction work. The contractor adds his profit margin to the total cost of works to arrive at the cost of executing the project and provides the client with these figures.

Estimating for Planning and Scheduling

The contractor plans and schedules how the whole project would be carried out from start to finish. This enables him to organise the project and resources needed to complete the project. This process involves:

- Placing orders for materials, along with the selected vendors
- Taking deliveries, transporting, and storing materials
- Recruiting and selecting human resources i.e., supervisors, engineers, and managers, etc.
- The procurement, transport, erection, and dismantling of equipment and plants
- Payment of wages and salaries

The contractor is expected to develop a construction program for expenditure based on the bill of quantities before construction work begins. The construction program serves as a guide to scheduling activities within unit time frames (e.g. daily or weekly activities). The estimated cost of the activities can then be easily computed from the cost estimates already discussed in the previous paragraphs and the cost per unit time (whether daily or weekly) is ascertained.

Estimation for planning and scheduling involves:

- i) Preparing of bill of quantities
- ii) Preparing of construction programme
- iii) Identifying the activities to be undertaken
- iv) Splitting the costs of items identified in (iii) above

Estimation for Variations

Variations arise during construction as a result of:

- i) User intends to introduce changes in the structure
- ii) Changes in assumptions made at the time of design and drawing, e.g. foundation depth may differ during the construction

Forms of variations include additional work, cancellation of work and alteration or replacement of an item with a new one. Variations results in changes to the work and these changes involve a cost factor which has to be estimated.

The supervisor is expected to provide important input in estimating the costs of variations for the three forms of variations, which are as follows:

a) Additional Work

Additional work results in extra cost which is added to the cost of the original work. Computing this extra cost involves listing all additional work and their quantities. The rates (labour, equipment etc.) are calculated in similar fashion to the usual methods presented for computing rates for new undertaking activities.

b) Deleted Work

The costs associated with all works which have been deleted are deducted from the original approved cost. This requires writing down deleted items, their quantities and their costs at the estimated rate worked out.

c) Alteration

Alterations involve adding or subtracting from an existing item. When adding, the procedure for (a) above is employed while deductions involve using the procedure from (b) above. The arithmetic difference between cost for (a) and (b) results in the alteration costs. If cost at (a) is greater than (b), then an additional cost is incurred. Conversely, if cost at (b) is more than (a), then there is reduction in the cost of work.

Estimating, for Revision of Project Budgets

Project Budget

The budget is the financial plan for the project which serves as the yardstick for comparison with the actual cost during the course of executing the project. The plan for the project is designed in the form of construction program which details all sequential steps for performing activities. It is imperative to first of all secure the resources needed in advance before starting an activity. This means that the expenditure will have to be incurred in advance before the actual activity is initiated.

The construction program which shows the start and finish of activities will have to be translated into:

- i) Work relating to activities currently in progress and associated costs
- ii) Work relating to activities to be performed in future and associated costs

Illustration

- i) A construction supervisor who needs masonry to be done next day has to pay labour costs
- ii) If materials need to be brought to the construction site, then, he has to pay for the transporting of material and charge it to concrete item
- iii) If certain other materials are required the following week, the supervisor must pay in advance and make costs chargeable to the items

The detailed program of expenditure for each day is used as the budget by field staff.

Revised Project Budget

During actual execution of work, the original project budget may undergo several revisions due to the changing nature of the project. This revision may be due to:

- i) Delay or early completion of work
- ii) There may be addition, deletion, or alteration of various aspects of project/s
- iii) Change in prices of items

The construction supervisor needs to undertake accurate evaluation of all these changes and make the necessary adjustment to the budget to reflect this dynamism.

Further Reading:

- ✓ *Martin Brook, (2008), Estimating and Tendering for Construction Work*
- ✓ *David J. Pratt, (2004), Fundamentals of Construction Estimating*
- ✓ *Brian Greenhalgh, (2013), Introduction to Estimating for Construction*