Estimating Guide

By RS MEANS Estimating Handbook

Types of Estimates

Several different levels of estimates are used to project construction costs. Each has a different purpose. The various types may be referred to by different names and some may not be recognized by all as necessary or definitive, though most estimators will agree to several basic levels, each of which has its place in the construction estimating process. In this text, the levels of estimates are broken down as follows.

1. **Order of Magnitude Estimates:** The order of magnitude estimate could be loosely described as an educated guess It can be completed in a matter of minutes Accuracy is plus or minus 20%.

2. **Square Foot and Cubic Foot Estimates**: This type is most often useful when only the proposed size and use of a planned building is known Very little information is required Accuracy is plus or minus 15%.

3. **Assemblies Systems Estimate**: An assemblies estimate is best used as a budgetary tool in the planning stages of a project Accuracy is expected at plus or minus 10%.

4. **Unit Price Estimate**: Working drawings and full specifications are required to complete a unit price estimate It is the most accurate of the four types but is also the most time consuming Used primarily for bidding purposes, accuracy is plus or minus 5%.

Order of Magnitude Estimates: The Order of Magnitude estimate in be completed when only minimal information is available. The proposed use and size of the planned structure should be known and ay be the only requirement The "units can be very general and need not be well defined. For example "An office building for a small service company in a suburban industrial park will cost about $500,000" This type of statement (or estimate) can be made after a few minutes of thought used to draw upon experience and to make comparisons with similar projects from the past While this rough figure might be appropriate for a project in one region of the country, an adjustment ay be required for a change of location and for cost changes over time (price changes, inflation, etc).

Square Foot and Cubic Foot Estimates: The use of Square Foot and Cubic Foot estimates is most appropriate prior to the preparation of plans or preliminary drawings, when budgetary parameters are being analyzed and established Costs may be broken down into different construction components, and then into the relationship of each component, then the project as a whole, in terms of costs per square foot. This breakdown enables the designer, planner or estimator to adjust certain components according to the unique requirements of the proposed project.

Historical data for square fool costs of new construction are plentiful. However, the best source of square foot costs is the estimator's own cost records for similar projects, adjusted to the parameters of the project in question. While helpful for preparing preliminary budgets, Square Foot and Cubic Foot estimates can also be useful as checks against other, more detailed estimates. While slightly more time is required than with Order of Magnitude estimates, a greater accuracy (plus or minus 15%) is achieved due to more specific definition of the project.

Assemblies (or Systems) Estimates: Ever increasing design and construction costs make budgeting and cost efficiency increasingly important in the early stages of building projects. Never before has the estimating process had such a crucial role in the initial planning Unit Price estimating, because of the time and detailed information required, is not suited as a budgetary or planning tool. A faster and more cost effective method is needed for the planning phase of a building project, this is the "Systems," or "Assemblies" estimate. The Assemblies method is a logical, sequential approach which reflects how a building is constructed. Twelve "Uniformat" divisions organize building construction into major components that can be used in Assemblies estimates. These Uniformat divisions are listed below:

Assemblies Estimating Divisions

Division 01-Foundations

Division 02-Substructures

Division 03-Superstructure

Division 04-Exterior Closure

Division 05-Roofing

Division 06-Interior Construction

Division 07-Conveying

Division 08-Mechanical

Division 09-Electrical

Division 10-General Conditions

Division 11-Special

Division 12-Site Work

Each division is further broken down into individual assemblies. Each individual assembly incorporates several different items into a system that is commonly used in building construction.

In the Assemblies format, a construction component may appear within more than one division For example, concrete is found in Division 1- Foundations, as well as in Divisions 2,3 and 12 (see list above). Conversely, each division may incorporate many different areas of construction, and the labor of different trades.

A great advantage of the Assemblies estimate is that the estimator/designer is able to substitute one system for another during design development and can quickly determine the cost differential The owner can then anticipate accurate budgetary requirements before final details and dimensions are established.

Final design details of the building project are required for a Unit Price estimate. The Assemblies method does not require such details, but the estimators who use it must have a solid background knowledge of construction materials and methods, Building Code requirements, design options, and budgetary restrictions.

The Assemblies estimate should not be used as a substitute for the Unit Price estimate. While the Assemblies approach can be an invaluable tool in the planning stages of a project, it should be supported by Unit Price estimating when greater accuracy is required.

Unit Price Estimates

The Unit Price estimate is the most accurate and detailed of the four estimate types and therefore takes the most time to complete. Detailed working drawings and specifications must be available to the unit price estimator. All decisions regarding the building's materials and methods must have been made before this type of estimate can be completed. There are fewer variables, and the estimate can, therefore, be more accurate. The working drawings and specifications are needed to determine the quantities of materials, equipment, and labor. Current and accurate costs for these items (unit prices) are also necessary.

Because of the detail involved and the need for accuracy, Unit Price estimates require a great deal of time and expense to complete properly. For this reason, Unit Price estimating is often used for construction bidding. It can also be effective for determining certain detailed costs in conceptual budgets or during design development. Most construction specification manuals and cost reference books, such as *Means' Building Construction Cost Data*, divide all Unit Price estimating information into the sixteen CSI MASTERFORMAT divisions.

Before Starting the Estimate

In recent years, drawings and specifications have become massive volumes containing a wealth of information. It is of utmost importance that the estimator read all contract documents thoroughly. They exist to protect all parties involved in the construction process. The contract documents are prepared so that the estimators will be bidding equally and competitively, ensuring that all items in a project are included. The contract documents protect the designer (the architect or engineer) by ensuring that all work is supplied and installed as specified. The owner also benefits from thorough and complete construction documents, being guaranteed a measure of quality control and a complete job. Finally, the contractor benefits because the scope of work is well defined, eliminating the gray areas of what is implied but not stated "Extras" are more readily avoided. Change orders, if required, are accepted with less argument if the original contract documents are complete, well stated, and most importantly, read by all concerned parties.

During the first review of the specifications, all items to be estimated should be identified and noted. The General Conditions, Supplemental Conditions, and Special

Conditions sections of the specifications should be examined carefully. These sections describe the items that have a direct bearing on the proposed project, but may not be part of the actual physical construction. An office trailer, temporary utilities, and testing are examples of these kinds of items.

While analyzing the drawings and specifications, the estimator should evaluate the different portions of the project to determine which areas warrant the most attention For example, if a building is to have a steel framework with a glass and aluminum frame skin, then more time should be spent estimating Division 5-Metals, and Division 8-Doors, Windows and Glass, than Division 6-Wood and Plastics. The estimator should determine, for a given project, the relative proportions of each component, and estimating time should be allocated accordingly. More time and care should be given to estimating those areas, which contribute more to the cost of the project.

Perhaps the best way for an estimator to approach a project is to begin with a clear mind and a clear desk. Clutter and confusion can have detrimental effects on the efficiency and accuracy of the estimate.

The Quantity Takeoff

Quantities may be taken off by one person if the project is not too large and time allows. For larger projects, the plans are often split into several disciplines (or divisions) and the work assigned to two or more quantity surveyors. In this case, a project leader is assigned to coordinate and assemble the estimate.

When working with the plans during the quantity takeoff, consistency is the most important consideration. If each job is approached in the same manner, a pattern will develop, such as moving from the lower floors to the top, clockwise or counterclockwise. The choice of method is not important, but consistency is. The purpose of being consistent is to avoid duplications as well as omissions and errors. Pre-printed forms provide an excellent means for developing consistent patterns.

General Rules for the Quantity Takeoff: General rules have been established for improving the speed, ease, and accuracy of the takeoff process. Quantity estimators should adhere to these rules. An accurate quantity takeoff is critical to the accuracy of a cost estimate, since no estimate will be reliable if a mistake is made in the quantity takeoff, no matter how precise the unit price information may be.

General Rule 1

When taking off quantities, follow the guidelines provided by the person who will be applying unit prices to the quantities (the cost estimator). The takeoff should be clear and informative to prevent misinterpretation. Use symbols, sketches, or footnotes to clarify ambiguities in the takeoff. The quantity estimator should think of him or herself as an assistant to the cost estimator.

General Rule 2

A takeoff list is not just a list of materials, but a list of measurements separated into categories to which unit prices are applied. The quantity sheets should be relatively

simple to use. The name of the building component is written in the far left-hand column labeled Description. The number of components called out on the plans is listed next, followed by their dimensions (such as length, width, and depth or height. Quantities of items that are taken off of the component are listed in the subsequent columns. When taking off strip footings, for example, the associated items include structural excavation, concrete, formwork, backfill, and disposal Appropriate units of measure, such as cubic yards of concrete, square feet of forms, and linear feet of pour strips, are applied to each item.

If more than one building component is listed on the same quantity sheet, or if there are several different sizes of the same component, then quantities are listed in the appropriate columns and totaled at the bottom of the page In this way the quantity estimator can calculate, for instance, the total number of cubic yards of concrete needed for strip footings for the entire building and write it in one sum at the bottom of the column labeled Concrete".

General Rule 3

A quantity estimator may begin the takeoff with any building component and proceed in the order of his or her choice. A good approach is to follow roughly the order of the actual field construction, such as from the footings upward to the roof This provides the quantity estimator with the clearest mental picture of the project. If a project consists of more than one building, each structure should be taken off separately, since unit costs may vary from structure to structure.

General Rule 4

Check the drawings and details carefully for notes such as 'NTS" (Not To Scale), changes in the scale as it is used throughout the drawings, drawings reduced to one-half or one-quarter their original size, or discrepancies in the specifications and the plans. Be consistent when listing dimensions.

General Rule 5

Where possible, use the dimensions stated in the drawings instead of measuring by scale, but make a habit of frequently checking printed dimensions with a scale or with mental arithmetic to spot draftsman's errors. Always express dimensions in the same order, such as

Length x width x height (or depth)

General Rule 6

Use a systematic procedure when working with the drawings For instance, take measurements in a clockwise direction around a floor or roof plan, first recording the measurements of items displayed horizontally on the drawings, and then recording those shown vertically. This method is most useful when taking off two-dimensional areas.

General Rule 7

Whenever possible, the items in a quantity takeoff should be identified by their location on the drawings.

General Rule 8

A quantity estimate is not intended for direct purchasing of materials. In fact, many items on a quantity estimate have no material value. These are called work items and are simply areas that require labor, such as fine grading gravel or finishing concrete surfaces. Work items may not appear on the drawings but are nonetheless required to complete the job. The quantity estimator should pay close attention to areas that may contain labor requirements. Items that do have material value are called material items. Both material items and work items are assembled on the same form for eventual pricing out, or cost estimating. Any item that has a cost value should be assigned a unit of measure, even if it is only in lump sum (LS) form The term 'lump sum" is used for certain work items that cannot be measured or expressed in any other way "LS" calls the estimator's attention to an item that requires a judged cost allowance.

General Rule 9

Decimals are used in quantity takeoff instead of fractions because they are faster, more precise, and easy to use on a calculator. Drawing dimensions that are given in feet and inches are converted to decimal feet, that is, feet and tenths of a foot.

General Rule 10

Quantity takeoff is performed for cost estimating purposes. Since estimating is not an exact science, the lists of quantities need not be overly precise. An example of unnecessary precision is calculating excavation quantities to 1/ 8". However, a reasonable degree of precision is expected. No detailed estimator wants to be accused of ballpark estimating. In most cases, the use of two decimal places is sufficient for quantity surveying purposes (12' 4-1 2" = 12.38') and easy to enter into a calculator. However, when writing the product of the calculation, decimals are usually meaningless. Develop rules for precision that are consistent with measurement capabilities. Below is an example:

ITEM	**Nearest UNIT**
Earthwork	Cubic Foot or Cubic Yard
Concrete	Cubic Foot or Cubic Yard
Formwork	Square Foot
Finishing and Precast	Square Foot
Lumber	Board Foot
Finishes	Square Foot or Square Yard

The quantity estimator must also learn the standards of each industry. For instance, a lumber dimension of 12' 1-1/2" must be rounded up to14' due to standard sawmill cutting practices.

Finally, do not convert units until all items in a column are totaled. For instance, keep concrete in cubic feet (C F) until all of the quantities listed in the concrete column have been added together. Then convert to cubic yards (CY)

General Rule 11

The quantity estimator should add an allowance for waste to certain quantities. Before the waste allowance is made, the quantities are referred to as net quantities. After the allowance for waste is added, the quantities are considered gross quantities.

General Rule 12

Ideally, a second quantity takeoff should be performed by a separate individual or team to ensure that no items have been omitted or duplicated. Unfortunately, the personnel to perform a second estimate are usually not available, or the cost to hire additional help is prohibitive. Typically, the quantity estimator systematically must check his or her own work. In fact, the quantity estimator should check the dimensions taken from drawings while someone other than the original quantity estimator should check the extensions.

General Rule 13

One way to avoid omissions and duplications is to mark the drawings as items are taken off. Make colored pencil shadings and check marks directly on the drawings as items are taken off. Most quantity estimators have their own methods of marking drawings. Usually a combination of methods is used, rather than a single method, as one kind of mark may be effective in taking off one particular category, and different marks effective for other categories. The quantity estimator may assume that any item on a drawing that has not been marked has not been taken off yet.

When work is interrupted, for whatever reason, select a natural stopping point and mark it clearly so that when work resumes, no items are missed or duplicated.

Systematic application of these rules will make the quantity estimators job faster, easier, and more accurate Refer to the general rules in this chapter whenever necessary.

Pricing the Estimate

When the quantities have been determined, then prices, or unit costs, must be applied in order to determine the total costs. Depending upon the chosen estimating method (and thus the degree of accuracy required) and the level of detail, these unit costs may be direct or bare costs, or may include overhead, profit or contingencies. In Unit Price estimating, the unit costs most commonly used are bare, or unburdened. Items such as overhead and profit are usually added to the total direct costs on the bottom line, at the time of the estimate summary.

No matter which source of cost information is used, the system and sequence of pricing should be the same as those used for the quantity takeoff. This consistent approach should continue through both accounting and cost control during construction of the project.

Types of Costs: Unit price estimates for building construction may be organized according to the 16 divisions of the CSI MASTERFORMAT. Within each division, the components or individual construction items are identified, listed, and priced. This kind of definition and detail is necessary to complete an accurate estimate. In addition, each "item" can be broken down further into material, labor, and equipment components.

All costs included in a Unit Price estimate can be divided into two types direct and indirect. Direct costs are those directly linked to the physical construction of a project, those costs without which the project could not be completed. The material, labor, and equipment costs mentioned above, as well as subcontract costs, are all direct costs. These may also be referred to as bare, or 'unburdened' costs.

Indirect costs are usually added to the estimate at the summary stage and are most often calculated as a percentage of the direct costs They include such items as sales tax on materials, overhead, profit and contingencies, etc. It is the indirect costs that generally account for the greatest variation in estimating.

Types of Costs in a Construction Estimate

DIRECT COSTS	INDIRECT COSTS
Material	Taxes and insurance
Labor	Overhead
Equipment	Profit
Subcontractors	Contingencies
Project Overhead	

The Paperwork: At the pricing stage of the estimate, there is typically a large amount of paperwork that must be assembled, analyzed, and tabulated. Generally, the information contained in this paperwork is covered by the following major categories:

- Quantity takeoff sheets for all general contractor items
- Material supplier written quotations
- Material supplier telephone quotations
- Subcontractor written quotations
- Equipment supplier quotations
- Cost Analysis or Consolidated Cost Analysis sheets
- Estimate Summary sheet

A system is needed to efficiently handle this mass of paperwork and to ensure that everything will get transferred (and only once) from the quantity takeoff to the Cost Analysis sheets. Some general rules for this procedure are:

- Write on only one side of any document where possible.
- Code each sheet with a large division number in a consistent place, preferably near one of the upper corners.
- Use Telephone Quotation forms for uniformity in recording prices received from any source, not only telephone quotes.
- Document the source of every quantity and price.
- Keep each type of document in its pile (Quantities, Material, Subcontractors, Equipment) filed in order by division number.
- Keep the entire estimate in one or more compartmented folders.
- When an item is transferred to the Cost Analysis sheet, check it off.
- If gross subcontractor quantities are known, pencil in the resultant unit prices to serve as a guide for future projects.

All subcontract costs should be properly noted and listed separately. These costs contain the subcontractor's markups, and will be treated differently from other direct costs when the estimator calculates the general contractor's overhead, profit, and contingency allowance.

The Estimate Summary: When the pricing of all direct costs is complete, the estimator has two choices: all further price changes and adjustments can be made on the Cost Analysis or Consolidated Estimate sheets, or total costs for each subdivision can be transferred to an Estimate Summary sheet so that all further price changes, until bid time, will be done on one sheet.

Unless the estimate has a limited number of items, it is recommended that costs be transferred to an Estimate Summary sheet. This step should be double-checked, since an error of transposition may easily occur. Pre-printed forms can be useful, though a plain columnar form may suffice.

If a company has certain standard listings that are used repeatedly, it would save valuable time to have a custom Estimate Summary sheet printed with the items that need to be listed Appropriate column headings or categories for any estimate summary form are:

- Material
- Labor
- Equipment
- Subcontractor
- Total

As items are listed in the proper columns, each category is added, and appropriate markups applied to the total dollar values Generally, the sum of each column has different percentages added near the end of the estimate for indirect costs.

- Sales tax
- Overhead
- Profit
- Contingencies

Since over 50% of the work on a typical building is performed by subcontractors, two aspects of bid preparation deserve special attention. The first is a clear understanding of the contractor's scope of work, which is essential, not only to compare the bids of competing subs, but to ensure that **you** have included all the items that the subcontractors may have excluded (such as cutting and patching, temporary protection, scaffolding, hoisting, etc). The second is that subcontractor prices typically do not arrive until bid day, which leaves little time to analyze competing bids, and makes last-minute gaps in coverage difficult to address if you have not done the necessary coordination with these subs beforehand.