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## CHAPTER TWENTY

# COST ESTIMATING

To adequately define the project scope and to ensure that sufficient construction funds are available, a construction cost estimate is required during the various stages of project development. As the project progresses, the estimate is updated to ensure the project remains cost-effective, that sufficient funds are available for construction, and that the contractor's bid price is reasonable. This Chapter discusses the project cost estimates required and who is responsible for their preparation.

### **20-1.0 PROJECT ESTIMATES**

#### **20-1.01 Project Initiation Estimate**

Each district is responsible for nominating projects to be included on the Department's Multi-Year Highway Improvement Program. Two notable exceptions are major-improvement studies and the Interstate System rehabilitation program, which are nominated by the Planning Division. Once a project is nominated, the Urban and Corridor Planning Office is responsible for gathering the necessary project information before it can be included on the Program list. One part of this information-gathering includes a preliminary cost estimate for construction. The preliminary cost estimate is generally provided by the entity which nominated the project. This estimate is determined using broad units of cost (e.g., cost per mile, cost per square yard), by the type of improvement and by reviewing similar, recent projects in the area.

#### **20-1.02 Preliminary Engineering Study Estimate**

The Environmental Policy Team, with input from the district, will prepare a more-detailed cost estimate for a project requiring an Engineer's Report. This estimate will be prepared based on the estimating procedures discussed below (e.g., cost per mile, cost per square yard). However, where quantities are available, these should be used. The Environmental Policy Team will be responsible for obtaining appropriate parametric cost estimate data.

A preliminary-study cost estimate is determined according to the following.

1. **Roadway Items.** For most roadway items, the cost estimate is determined assuming a cost per mile per roadway width. This estimate reflects the cost for earthwork, pavement structures, drainage, or other miscellaneous items. Every effort should be made to include all anticipated work items.

2. Structure Items. For most structural items, the cost estimate is determined assuming a cost per square yard based on similar structure type, work type (e.g., bridge rehabilitation, replacement) and crossing type (e.g., railroad, highway, stream).
3. Traffic-Signal Items. For a signal installation, a cost estimate is determined assuming a cost per intersection. For a signal-interconnect system, a cost estimate is determined assuming a cost per installation. These cost estimates will be provided by the Traffic Signals Team.
4. Traffic-Signs Items. The cost estimate is based on the number of panel signs and cost per sign. The cost estimate will be provided by the Signing and Lighting Team.
5. Lighting Items. Lighting is estimated assuming a cost per mile or per interchange where lighting will be provided. The cost estimates will be provided by the Signing and Lighting Team.
6. Traffic Maintenance. Include an estimate for traffic maintenance for each project. This estimate is determined by parametric means with the aid of previous projects of similar size, type, and complexity. For an expansion or major-preservation project, traffic maintenance costs range from 5 to 15 percent of the roadway or bridge construction items.
7. Right of Way. Right-of-way costs for an expansion or major-preservation project are furnished by the Office of Real Estate, including land cost, damages, and administration costs. Right-of-way cost for another project type is provided by the Administrative Services Team based on previous land-acquisition costs of similar projects.
8. Contingencies. For an expansion or major-preservation project, add a contingency factor for miscellaneous and lump-sum items based on 20 to 30 percent of the roadway or bridge construction items.
9. Preliminary Engineering. For a road project, add a preliminary-engineering cost of 3 to 6 percent based on the total of Items 1 through 8 above, excluding Item 7. For a bridge project, use 5 to 8 percent. The preliminary-engineering cost includes environmental, survey, design, and geotechnical work.
10. Unit Costs. If quantities are available, these quantities in conjunction with the average weighted unit prices from Estimator or CES are used to develop the estimate.

The user should add the cost of major features that are beyond the basic assumptions used to develop the estimate. For example, the cost for a major box culvert should be added to the roadway cost per mile estimate.

### **20-1.03 Design Estimates**

#### **20-1.03(01) Preliminary Field Check**

This is the first project stage for which the designer is responsible for preparing the cost estimate. The total from this estimate is included in the preliminary draft from the Design Summary. At this stage, the plans should be sufficiently advanced so that some of the major quantities can be approximated. The estimate should be based on these quantities and the average weighted unit prices. After entering all known quantities into Estimator or CES, the designer should include a 10 to 25 percent contingency factor based on engineering judgment for the miscellaneous items for which the quantities have not yet been determined. If the quantities are not available, the general cost estimating procedures discussed in Section 20-1.02 should be used (e.g., cost per mile per roadway width). The designer should contact the Production Management Division's Utilities and Railroad teams, and the Office of Real Estate to obtain an estimated cost for utilities, railroads, or right of way, unless previously supplied.

For a consultant-designed project, the consultant will be required to use the computer program Estimator to determine the preliminary cost estimate. Section 20-2.01 discusses the Estimator program. As with CES, Estimator will provide an initial cost estimate based on the available quantities. The consultant will be responsible for adjusting the values to reflect the project type, location, environment, and engineering judgment.

A project may have two or more Des numbers. For example, a combination roadway and bridge project will have multiple Des numbers. For this type of project, separate cost estimates are required for each Des number based on the quantities associated with that particular work category. The Office of Contracting will combine individual estimates within a single contract.

#### **20-1.03(02) Design Approval Plans**

Most major quantities should be known at this stage. However, if this is not true, the procedures described for determining the cost estimate in Section 20-1.03(01) are also applicable. Include the final total from the cost estimate in the Final Design Summary. The Design Summary is submitted to the Production Management Division director for approval including the total estimated cost. A complete cost estimate is required as an attachment to the Design Summary for an Interstate-route rehabilitation project, or to the Bridge Inspection Report for a bridge-rehabilitation project.

#### **20-1.03(03) Final Check Prints**

At this stage, the plans should be complete, and the preliminary cost estimate updated to a final cost estimate. All quantities should be finalized at this stage and entered into Estimator. Section 20-2.03 provides additional guidelines for determining a cost estimate based on quantities.

#### **20-1.03(04) Final Tracings**

Before submitting the final tracings, the designer must prepare a final detailed cost estimate based on the final plans and quantities. This may be an update of an earlier cost estimate. This estimate will be used by the Office of Contracting to develop the Engineer's Estimate.

For a local-public-agency project, the Office of Contracting will review the local agency's cost estimate and prepare the Department's cost estimate. This may be, but is not required to be, an independent estimate. If the difference between the local agency's cost estimate and the Office of Contracting's cost estimate is significant, the Local Program Assistance Team will contact the local public agency and negotiate an estimate acceptable to both parties.

If the cost estimate changes after the plans have been transmitted to the Office of Contracting due to changes in the quantities, the procedures described in Section 14-1.02(03) and 14-1.02(04) should be followed.

#### **20-1.03(05) Other Estimates**

The following indicates where new or revised cost estimates may be required during the design stage of a project.

1. Project Scope Change. If the scope of the project changes, the designer is responsible for obtaining a new construction cost estimate. If major changes on a Federal-aid project are over \$250,000 and if construction will occur in the current or next Federal fiscal year, forward the revised cost estimates to the Urban and Corridor Planning Office so that it can revise the Multi-Year Program. Estimates for scope of work changes are based on approximate quantities and are determined using the procedures discussed in Section 20-1.02.
2. Project Delay. If there has been a significant delay in the project since it was originally designed and estimated, it will be necessary to update the cost estimate.

#### **20-1.04 Engineer's Estimate**

The Engineer's Estimate will provide a basis for the Department's evaluation of the bids for highway construction and will allow the Department to determine if the low-bid price is fair and reasonable for the work involved. This estimate and the data used to generate the estimate are confidential and are not for general distribution.

After receiving the cost estimate, the Office of Contracting will ensure that the following reviews or activities occur.

1. Review of Estimate. The Office of Contracting will review the designer's estimate and check it for errors or omissions. If large discrepancies are noted, it will contact the designer to discuss and resolve differences.
2. Review of Contract Completion Time. The Office of Contracting will ensure that the cost estimate is compatible with the contract completion period set by the district construction personnel.
3. Review of Cost Estimate From Office of Real Estate. The Office of Contracting will add cost estimates from the Office of Real Estate to the designer's estimate to determine the final Engineer's Estimate.
4. Prepare Plans, Specifications, and Estimates (PS&E). For a Federal-aid-funded project, the Office of Contracting will include an estimate as part of the PS&E package submitted to FHWA.
5. Review Pre-Bid Meeting Comments. The Office of Contracting will review comments from the Pre-Bid Meeting to determine their effect, if any, on the cost estimate.
6. Opening and Processing Bids. After the public reading of the bids, the Office of Contracting will check the proposals for omissions or errors. If the low bidder satisfies all criteria and if the low bid is within a pre-established award range, the bid is forwarded for approval.
7. Rejection of Bids. If all bid estimates exceed the pre-established award range, the bids and contract are rejected and the re-advertising process begins. The Engineer's Estimate is reviewed with regard to the bids received.

## **20-2.0 ESTIMATING PROCEDURES**

### **20-2.01 Computer Estimates [Rev. Jan. 2011]**

Each construction-cost estimate must be submitted via the CES Cost Estimating System software. CES has a detailed user-guide manual that the designer should review before using the program. The manual can be obtained from the Office of Contracting or by contacting the Architecture and Application Development Division's TRNS • PORT (BAMS) Administrator.

In order to better-estimate construction costs in the future, and to analyze work done in the past, more information must be entered into CES for an in-house-designed project, or into Figure 20-2A, Consultant Project Input Form, for a consultant-designed project.

All consultant-designed-project-metrics information formerly submitted on the Consultant Project Input Form should not be entered directly into CES. The following project metrics should be submitted.

1. Latitude and Longitude. This information should be taken from the SPMS project schedule. If it is not shown there, the designer or estimator should determine the location of the midpoint of the project in degrees, minutes, and seconds. This data should be entered without units symbols. For example, 89° 59' 34'' is entered as 895934. This information is entered on the General tab, second page. Latitude or longitude information that is already present must be verified.
  - a. For a project that includes work on more than one route, the latitude and longitude should be entered for the point closest to the geographic center of all work.
  - b. For a district- or subdistrict-wide contract, the latitude and longitude should be entered for the district or subdistrict office.
2. Project Length, Pavement Width and Depth, and Lane Miles (Kilometers). This information should be entered on the the General tab, first page, bottom left, in the block titled Metrics. English units should be used for a metric-units project. Each entry should be rounded to two decimal places, as appropriate.
  - a. The project length is the overall length of pavement, entered in miles.
  - b. The pavement width is the total width of new mainline pavement, excluding paved shoulders, entered in feet.
  - c. The pavement depth is the average depth of new mainline pavement, excluding paved shoulders, entered in inches.
  - d. Lane miles is the project length times the number of through travel lanes, excluding shoulders, entered in miles.

The Consultant Project Input Form, Excel file 0527-inf.xls, previously used to submit the information described above in using the Estimator<sup>®</sup> project-estimation software, will no longer be required.

Cost estimates are based on the quantities and applicable unit prices. CES allows the designer to enter quantities or to develop cost estimates based on general estimating procedures (e.g., cost per square foot of bridge deck, cost per intersection). For Estimator, the user must input actual quantities into the program before it can generate a cost estimate. Once the quantities have been entered, the programs will automatically provide a cost estimate based on historical data from past bids. The Department is responsible for providing the base information used by the programs. This estimate may be used as-is. However, the designer should review the unit costs. Based on the proposed scope for the project, the designer should be aware of factors that may influence unit prices as follows:

1. geographic location (e.g., urban or rural, State location, district);
2. similarity of recent construction projects;
3. inflation (adjustments of past prices to reflect the current year);
4. reliability of recent construction cost data;
5. recent trends in cost of materials, labor, or equipment;
6. anticipated difficulty of construction;
7. project size relative to size of similar projects;
8. proposed project schedule;
9. anticipated construction staging;
10. expected environmental problems (e.g., hazardous wastes, wetlands);
11. use of experimental materials, which requires coordination with the Office of Research and Development; and
12. engineering judgment.

## **20-2.02 Coded Pay Items**

### **20-2.02(01) General**

Each pay item has an official title and code number which is tied to the *Standard Specifications*. These items are listed in the *INDOT Catalog of Unit Price Averages for Roads - Bridges - Traffic*. This document can be obtained from the Office of Contracting. These item numbers are used by the Department for tracking and as a historic data base. For most items, CES or Estimator will provide the official pay item number. However, for some specialty or new items, the construction item may not be within the computer. Therefore, the designer will be required to conduct the following.

1. Checking. The designer should ensure that there is an actual number for the item within the system by entering the item into CES or Estimator. Do not assume that the item is not in the system.

2. Specifications. The designer should review the *Standard Specifications*, Supplemental Specifications, or Recurring Special Provisions to determine if there is a method of payment for the item. If not, a special provision must be developed; see Section 19-2.0.

The designer should be certain that the CES or Estimator software's pay items catalog to be used in developing the estimate of quantities and cost estimate corresponds to that which is effective for the contract letting date. Pay item names, pay units, or code numbers are periodically revised, added, or deleted. It is the designer's responsibility to check the estimating software when these changes occur, and to be certain that they are reflected in the estimate of quantities and cost estimate throughout project development.

### **20-2.02(02) New Pay Item and Code Number**

If an item does not exist within the CES or Estimator program, the designer may request the Office of Contracting to develop a new pay item and code number. The designer should minimize this option as much as practical. The design should instead be modified slightly in order to use an existing pay item. Where necessary, use the following procedure to request a new pay item and code number.

1. Request. Send or fax a memorandum requesting a new pay item to the Office of Contracting. This memorandum should include the information as follows:
  - a. the proposed pay item name;
  - b. the pay unit, both English and metric;
  - c. the applicable *Standard Specifications* section reference;
  - d. 3 copies of the special provision for the item, double spaced; and
  - e. where applicable, plan details.
  
2. Comments. The Office of Contracting will review the request and may solicit comments from other Department entities. The written request for comments will include the information as follows:
  - a. the *Standard Specifications* section number;
  - b. a copy of the special provision;
  - c. plan details, where applicable; and
  - d. the Office of Contracting's comments on the request.

Those solicited for comments will be given five work days to return their comments.

3. Response. Upon receipt of all comments, the Office of Contracting will either approve the new pay item for use and assign it a new pay item code number, or it will recommend the use of an existing pay item by developing a supplemental description for an existing specification.

### **20-2.02(03) Bridge Identification in Pay Item Name**

A unique identifier should be assigned to each distinct bridge in the contract if required in a pay item name. For a set of twin structures, each bridge should therefore be assigned a unique identifier.

### **20-2.02(04) Non-Participating Pay Items [Added Sept. 2011]**

Figure 14-1C, Contract Preparation Documents to Contract Administration Division, includes a section for identification of non-participating pay items. These are pay items which FHWA cannot participate in the cost of, in an otherwise federal-aid project. The pay items should be identified as such in the cost estimate.

The most common non-participating pay items include the following.

1. Commemorative plaque on a bridge.
2. Work outside the right-of-way without permit.
3. Adjustment of private facilities not included in the right-of-way acquisition document such as signs; fences, lawn sprinklers, etc.
4. Costs incurred to salvage items for later use by the State are not eligible for federal participation. This includes transportation of materials or storage costs.
5. A betterment that is not currently part of the project. Example: excess sizing of a non-INDOT sewer for future development. The additional cost over replacement-in-kind should be borne by the owner of the facility being adjusted.
6. Purchase of equipment or supplies for retention by INDOT or an LPA that are not permanent project fixtures. Example: purchase of changeable-message signs for retention by INDOT.

### **20-2.03 Estimating Guidelines**

For most items, CES and Estimator will provide the designer with sufficient guidance in determining the appropriate cost for a specific item. However, the designer should consider the following.

1. Unit Cost. The unit cost will be based upon an average price data base maintained by the Department within CES and Estimator, price books, and unit cost bid tabulations. Adjustments to the unit cost may be appropriate based on the factors listed in Section 20-2.01.
2. Lump-Sum Pay Item. Desirably, a lump-sum item should not be used on a project. However, this is not always practical. Where necessary, only use a lump-sum item where the scope of work for the item is clearly defined and the amount of work has a minimal chance of changing during construction. In determining the unit price for a lump-sum item, the designer should consider the following.
  - a. Components. Most lump-sum items can be divided into individual parts for estimating purposes. For example, a temporary traffic signal structure can be divided into the pole installation, signal heads, controller, installation, maintenance, removal, etc. Once the elements have been segregated, the designer should use engineering judgment to determine the appropriate cost for each component.
  - b. Percentages. Some lump-sum items are determined based on a percentage of the total of the contract items (e.g., mobilization and demobilization, clearing right of way). These are further discussed below.
3. Clearing Right of Way. This is assumed to be 1 to 2 percent of the total contract cost. Factors that should be considered include project location, rural or urban, the type of clearing required (trees or brush), concentration of clearing, and method of disposal.
4. Temporary Bridge and Approaches. This should be segregated into its components as discussed in Item 2.a. For example, the cost of temporary approaches should be determined according to the amount of embankment required, width of pavement, drainage systems, etc. Temporary guardrail and temporary pavement markings are separate pay items.
5. Miscellaneous Items. The following pay items should always be included in the cost estimate.
  - a. Field Office. The pay unit is month. The number of months used for the final quantity and schedule of pay items is set by the district Office of Construction based on the estimated construction time.

- b. **Maintaining Traffic.** Maintaining traffic is a lump-sum item and will be determined based on its components. Elements that should be considered include traffic volume, traffic composition, peak times, number of lanes, length of construction, and type of work.
  - c. **Construction Engineering.** This will be determined by the computer. Construction engineering is determined using 2% of the total contract cost. This may require revision if significant engineering may be required during construction.
  - d. **Mobilization and Demobilization.** This is a lump-sum item and will be determined by the computer. Mobilization and demobilization is determined using 5% of the total contract cost including the amount for construction engineering. Mobilization and demobilization consists of preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site; for the establishment and removal of offices, buildings, and other facilities necessary for work on the project; and for all other work or operations that must be performed or costs incurred when beginning or ending work on the project.
6. **Other Cost Estimates.** Other entities will prepare their own cost estimates. The designer is responsible for ensuring that such entities receive the correct information so that they can properly prepare their estimates.
  7. **Other Information.** The designer should provide the Office of Contracting with information that may influence the cost of the project (e.g., special commitments, experimental materials, special equipment, expected construction difficulties).
  8. **Special Material.** Contact a supplier directly to obtain a quote for a special material. The quoted price is what a supplier hopes to receive for its product. The final price the contractor will be required to pay will be lower due to competition and negotiations between the contractor and supplier. Such an item as a discount for a large quantity, early payment, or extreme competition may impact the final price. The designer should adjust the quoted price based on these factors, previous estimates, and engineering judgment.
  9. **Incidentals.** Incidental costs cover work that may or may not be addressed by a specific contract pay item. Incidental costs may include the following:
    - a. work included in other items per the *Standard Specifications* or a special provision;
    - b. coordination with other contractors;
    - c. early completion date which demands multiple work shifts;

- d. payment of overtime;
  - e. winter construction;
  - f. congested work area;
  - g. high-elevation work;
  - h. hauling through heavy traffic, frequent railroad crossings, or traffic signals;
  - i. work not adaptable to the normal equipment used which results in manual labor or renting of special equipment;
  - j. location of plant sites, including costs of rental and renovation;
  - k. the season during which the work will be performed;
  - l. the cost of maintaining traffic including stage construction, flaggers, lights, barricades, or flashing-arrow signs; and
  - m. outside agencies' rules and regulations (e.g., OSHA, EPA).
10. Structural-Plate Pipe-Arch Unit-Price Data. For a large-culvert location, the hydraulics recommendation letter will include a structural-plate pipe-arch sizing as well as a precast-concrete box-structure or three-sided structure sizing. If this occurs, the designer should evaluate both structures at the structure type and size stage and choose the more economical alternate. If the hydraulics recommendation letter includes the option of a small- to medium-sized structural-plate pipe-arch, a deformed pipe type 1 should be shown on the plans so that the contractor has the option of providing either a corrugated-metal or an elliptical-concrete pipe.
- The Department has very little historical unit-price data for structural-plate pipe-arch structures. Data from recent bid tabulations is available from the Contract Administration Division's Office of Contracting. The designer should contact pipe suppliers for additional price information for a specific size. Some sample price data from specific contracts is shown in Figure 20-2B.
11. Three-Sided-Structure or Oversize-Box-Structure Unit-Price Data. This data may be found at [www.in.gov/dot/div/contracts/standards/bridges/3sidedculv.pdf](http://www.in.gov/dot/div/contracts/standards/bridges/3sidedculv.pdf).
12. Concrete-Structural-Members Unit-Price Data. Estimated unit prices for are listed in Figure 20-2C. The designer should adjust unit prices based on the quantities required for the

project. The designer should increase the unit price 20 to 50 percent for small quantities. The designer should further check with a fabricator.

**CONSULTANT PROJECT INPUT FORM  
ENGLISH-UNITS PROJECT**

Des No.	Std. Spec. Year: 2010
Route No. or Road Name:	
Work Type:	
Project Length, 4 decimal places:       mi	Latitude:       °       '       "
Pavement Width, 4 decimal places:       ft	
Pavement Depth, :       in.	Longitude:       °       '       "
Lane Miles, 1 decimal place:       mi	

If pavement work is not required, the width and depth fields should be left blank.

In saving the completed form, it should be identified as [Submittal] ConProjInFrm [Des No.] for [Bridge, Roadway, Contract] Services. An example reads FT ConProjInFrm 1012345 for Contract Services.

Contract	LETTING DATE	ITEM	DESCRIPTION	Quantity	UNIT PRICE
R-20165	9-16-97	717-26046	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 28 sq ft	95 LFT	\$140
B-22807	12-17-96	717-26166	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 43 sq ft	78 LFT	\$210
R-23259	10-22-97	717-26236	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 55 sq ft	104 LFT	\$275
B-20916	6-04-96	717-26256	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 58 sq ft	110 LFT	\$150
R-22693	2-11-97	717-26306	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 64 sq ft	188 LFT	\$250
R-23259	10-22-97	717-26411	Pipe Arch, 0.109 in. T&S, 0.138 in. Bot, 81 sq ft	114 LFT	\$300
M-23445	2-10-98	717-04722	Pipe Arch, 0.168 in. T&S, 0.188 in. Bot, 119 sq ft	100 LFT	\$396
R-22445	3-19-96	717-26656	Pipe Arch, 0.138 in. T&S, 0.168 in. Bot, 131 sq ft	110 LFT	\$325
R-23392	2-10-98	717-26657	Pipe Arch, 0.168 in. T&S, 0.188 in. Bot, 142 sq ft	140 LFT	\$264
M-23686	7-14-98	715-05252	Pipe, Type 1, Deformed, 20.5 sq ft	28 LFT	\$128
R-23126	12-16-97	715-05027	Pipe, Type 1, Deformed, 20.5 sq ft	128 LFT	\$175
R-23126	12-16-97	715-05042	Pipe, Type 1, Deformed, 21.9 sq ft	136 LFT	\$100
RS-24801	3-20-01	715-05254	Pipe, Type 1, Deformed, 21.9 sq ft	40 LFT	\$196
M-23589	8-11-98	715-05260	Pipe, Type 1, Deformed, 27.4 sq ft	40 LFT	\$145
R-24432	2-22-00	715-05265	Pipe, Type 1, Deformed, 32.1 sq ft	315 LFT	\$220
R-24729	2-22-00	715-05272	Pipe, Type 1, Deformed, 37.0 sq ft	158 LFT	\$207
R-23907	11-16-99	715-05298	Pipe, Type 1, Deformed, Min. Area 74.3 sq ft	98 LFT	\$290

**SAMPLE CONTRACT UNIT PRICES  
PIPE-ARCHES AND DEFORMED PIPE**

**Figure 20-2B**

Description	Cost per Linear Foot
Type I	\$66.00
Type II	\$88.00
Type III	\$102.00
Type IV	\$125.00
Bulb Tee, 54 in.	\$114.00
Bulb Tee, 66 in.	\$120.00
Bulb Tee, 73 in.	\$140.00

**English Units**

**CONCRETE STRUCTURAL MEMBERS UNIT COSTS**

**Figure 20-2C**