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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 various 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 generally 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 any project requiring an Engineer's Report. This estimate will typically be prepared with the general 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 typically determined assuming a cost per intersection. For a signal interconnect system, a cost estimate is typically 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 typically range from 5 to 15 percent of the roadway and/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 costs 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 and/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.

In addition, the user should add the cost for any 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 typically the first project stage where 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/bridge project will have multiple Des numbers. For this type of projects, 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 assure 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 any 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 meets 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 is 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

The Department uses two computer programs to help develop and track cost estimates, Cost Estimating System (CES) and Info Tech's Estimator. CES is used internally by INDOT until the

final estimate to develop preliminary cost estimates. CES is located on the Department's internal computer network system. CES can be imported into Estimator.

Estimator is used by consultants to determine the preliminary cost estimate. Estimator is also used by the Department's in-house and district designers. Estimator is a Microsoft Windows-based program.

Each program has detailed user-guide manuals that the designer should review before using the program. These manuals 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. The additional information to be required is as follows:

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. However, the units symbols should be omitted. For example, 89º 59' 34'' would be entered as 895934. For an in-house design, this information is entered on the second page of the General tab. For a consultant design, this information is entered on the right-hand side of the Consultant Project Input Form.

   For a contract that includes work on more than one route, e.g., guardrail repair, traffic signal bulb replacement, mowing, herbicide treatment, etc., the latitude and longitude of the point closest to the geographic center of all work should be entered.

2. Project Length, Pavement Width and Depth, and Lane Miles. For an in-house design, this information should be entered on the first page of the General tab at the bottom left of the page in the block titled Metrics. For a consultant design, the values, excluding units, are entered on the left-hand side of the Consultant Project Input Form.

   a. The project-length unit is mile.

   b. The pavement width is the total for the new pavement work, including paved shoulders, being done. The unit is foot. The pavement depth is the average for the new pavement work, including paved shoulders, being done. The unit is inch.

   c. Lane miles is the project length times the number of travel lanes of pavement work, excluding shoulders. The unit is mile.

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/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 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. It is important for the designer to minimize this option as much as practical. It is preferred that the design 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 the 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.

20-2.03 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. Clearing right of way is typically 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. Temporary bridge and approaches should be segregated into the various components as discussed in Item 2.a. For example, 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 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 various components. Elements that should be considered include traffic volumes, 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 item 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 costs consist 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 any information that may influence the cost of the project (e.g., special commitments, experimental materials, special equipment, expected construction difficulties).

8. Special Materials. Contact the suppliers directly to obtain quotes for special materials. The quoted prices are what suppliers hope to receive for their product. The final price the

contractor will be required to pay will generally be lower due to competition and negotiations between the contractor and supplier. Such items as discounts for large quantities, early payment, or extreme competition may impact the final price. The designer should adjust the quoted prices 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. tight 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, flagmen, 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/design/consult.htm.

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.