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MONTANA DEPARTMENT OF TRANSPORTATION

ROAD DESIGN MANUAL

Chapter Seven

CONSTRUCTION COST ESTIMATES

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CONSTRUCTION COST ESTIMATES

Chapter Five presents the Montana Department of Transportation procedures for the preparation of quantity summaries. The Department and contractors use these quantities to determine the cost for construction of the project. Chapter Seven provides information on the various pre-construction cost estimates required during project development and the procedures for developing these estimates.

7.1 PROJECT ESTIMATES

Project estimates are used by Fiscal Programming and the districts to develop the 5-year Tentative Construction Plan (TCP - Red Book) to ensure that sufficient funds are available for construction. The TCP is MDT's best estimate of when projects will be let and what the costs will be. The Engineering Division uses the TCP to prioritize project design. Accurate cost estimates ensure that designers are working on the appropriate projects. If cost estimates are too low, there won't be enough money to fund all of the designed projects. As a consequence, resources will be focused on projects that can't be let to contract until the next fiscal year. If cost estimates are too high, the TCP will under-estimate the number of projects designed for the fiscal year. This could result in hurried designs or even the loss of federal funding.

During project development, several cost estimates are prepared to determine and refine the expected project construction costs. The following presents the various cost estimates that are prepared during project development and who is responsible for preparing each estimate. Figure 7.1A provides the recommended distribution list for each of these cost estimates. The estimate is included in the distribution of the reports listed below. Figure 7.1B provides the format for showing the project estimate in the PFR, AGR and SOW reports. Detailed itemized estimates should be included in the PIH and FPR reports. Cost estimates are developed at the following project stages:

1. Project Programming/PFR. The District Office is responsible for nominating projects to be included on the Department's Program of Projects. When the District Office submits these nominations, they are also required to submit a rough cost estimate for each project. This estimate is typically revised after the Preliminary Field Review when a more detailed evaluation can be made of project issues using input from all the technical areas. Some common methods for estimating costs before quantities are available are listed below. More than one method can be used to compare for more confidence. Use the highest level of estimating possible, document all assumptions, and provide a written estimate.

a. Cost per mile. Use similar projects in region that were let in the past 6 months – year. Be sure to consider additional items and add estimated amounts appropriately. Some of the items to be considered are listed below:

   1) Guardrail
   2) ADA ramps, curb and gutter, sidewalk work
   3) Storm drain
   4) Large culverts, irrigation facilities
   5) Traffic signals, lighting
   6) Turn bays, other isolated widening
   7) Bridge work
   8) Retaining structures
   9) Wetland mitigation, wildlife crossings, wildlife fencing, etc.
   10) Constructability issues
   11) Pavement markings, signing
   12) Traffic control issues

b. Cost per square yard from the current Pavement Condition and Treatment report published by the MDT Pavement Analysis Section. Determine the project area and multiply by the appropriate cost/yd^2 taken from the cost trend table.

c. Estimated quantities – estimate quantities for the major bid items.
   Consider the proportion of the project that the major items comprise and increase cost accordingly. Consider additional items from list above.

d. Cost Estimation module from HEAT program – update into current bid estimate sheet. Consider additional items listed above that aren't accounted for in module input.

e. Similar project comparison – for small, specialty projects.
   Compare to similar projects that were let recently and adjust for differences in project scope, regional cost variations, constructability issues, etc.

f. Contingency is an unintended or unlikely event that may occur for which project funds should be allocated, while risk is the possibility of suffering harm or loss. Contingency should be considered in quantifiable and non-quantifiable outcomes; costs can be assigned to the known issues, and contingency is assigned to the identified issues that will likely occur with unknown costs. Risks are assigned to issues that are identified that may occur or to issues that have not yet been identified. Contingency and risk depend on scope of project and known/unknown conditions. Given a thorough field review that includes

consideration and discussion of the potential issues, contingency should be 10% to 25%.

2. Alignment and Grade Review/Report. The designer is responsible for determining the first detailed construction cost estimate at this stage of project development. For projects over $12 million, a cost estimate team should be convened to review the known and unknown issues and the probabilities for risk issues. Do not use the initial project estimate developed by the District Office. The major items including grading, surfacing, and large drainage facilities can be estimated more accurately. Costs for individual bid items should be adjusted based on past bid history and individual item contingency or risk. This estimate should be determined using the following:

   a. Cost estimate spreadsheet – estimate quantities for the major bid items. Major bid items are those items that make up 65% to 85% of the total project cost.
   Add costs for the items from list above that haven't yet been designed. Consider the proportion of the project that the major items comprise and increase cost accordingly. Get estimates from the other technical sections for specialty issues.

   b. Cost per mile or similar project comparison. This should be used with discretion at this stage. Cases that may require this method would include projects with alternate alignments.

   c. Contingencies depend on scope of project and known/unknown conditions: 10% - 25%

   d. Consider potential constructability issues, and the potential unknown factors that may arise.

   e. Inflation should be based on the project schedule from OPX2 and TCP: determine the realistic amount of time remaining to complete the project design and add time for letting. Take to the midpoint of construction.

   f. Specific Items. The designer should contact the Bridge Bureau to determine the estimated cost for large bridges within the project limits. These estimates are typically based on the sq. ft. (m2) of bridge surface. The Traffic Engineering Section will be responsible for providing a preliminary estimate if special elements such as signalization, extensive lighting or other permanent traffic control devices are included in the project.

g. Traffic Control should be based on similar projects in the district. Nationwide studies have found no correlation between traffic control costs and total project costs; therefore, percentage based traffic control should not be used.

Distribution	Programming Project	Alignment And Grade Review/ Report	Scope of Work Report	Plan-in-Hand Report	Final Review Report	Designer's Final Estimate
Rail, Transit and Planning Division	**X**	**X**	**X**			**X**
District Administrator(s)	**X**	**X**	**X**	**X**	**X**	**X**
Engineering Information Services Section — Engineering Division	**X**					**X**
Contract Plans Section						**X**
Secondary Roads Engineer — (STPS, SFCS Projects Only)	**X**	**X**	**X**	**X**	**X**	**X**
Urban Section — (Urban Projects Only)			**X**	**X**	**X**	**X**
Project Files	**X**	**X**	**X**	**X**	**X**	**X**
Fiscal Programming	**X**	**X**	**X**	**X**	**X**	**X**

COST ESTIMATE DISTRIBUTION
Figure 7.1A

3. Scope-of-Work Report. If a project does not have an Alignment and Grade Review, the designer will develop the first construction cost estimate which will be included in the Scope-of-Work Report. Prepare this estimate in a similar manner as discussed in Comment #2 for the Alignment and Grade Review. If an estimate was prepared for the Alignment and Grade Review, it will generally not be necessary to update the estimate for the Scope-of-Work Report.

4. Plan-in-Hand Report. The designer is responsible for updating the construction cost estimate for the Plan-in-Hand. At this stage of project development, the majority of the project quantities should be available. Section 7.2 describes the procedure that should be used to develop the cost estimate based on these project quantities. The Bridge Bureau and the Traffic Engineering Bureau will be responsible for providing the road designer with their cost estimates for bridge elements and permanent traffic control devices (e.g., signing, pavement markings, lighting, signalization), respectively. Consider potential constructability issues, and the potential unknown factors to arise. These should all be discussed in depth at the PIH review. The designer should use the following tools to accurately estimate the cost of the project:

   a. Cost estimate spreadsheet – estimate quantities for the all bid items. Include cost estimates from other design areas. Bridge costs, structural walls, landscaping and associated irrigation, signing and pavement markings, electrical items, and traffic control should be included. Discuss the cost estimate at the PIH review, spending time on the critical items and the impact of constructability issues on costs.

   b. Decision Support System (DSS)module – use the bid history to refine bid prices for regional and availability factors.

   c. Estimator can be used with discretion as a check on the cost estimate.

   d. Contingencies should be low, based on the level of known conditions: 5% - 10%

   e. Inflation should be based on the project schedule from OPX2 and TCP: determine the realistic amount of time remaining to complete the project design and take to the midpoint of construction.

   f. Traffic Control should be discussed thoroughly at the PIH review. Costs can be assigned.

5. Final Review Report. The construction cost estimate for the Final Review generally will only need to be an update of the estimate from the Plan-in-Hand.

The Bridge Bureau and the Traffic Engineering Section should provide the road designer with their updated cost estimates for bridge elements and permanent traffic control devices on the project.

6. Project Scope Changes. Whenever the scope of the project changes, the designer will be responsible for determining a new construction cost estimate. Estimates for scope of work changes are typically based on general quantities and are determined as discussed in Comment #2.

7. Final Plan Review Report. The Plan Checker will review the designer's final estimate.

8. Engineer's Estimate. The Engineer's Estimate is developed by using the final estimates from the various Sections and Bureaus involved with the project. The Contract Plans Bureau will be responsible for collecting and distributing the various units' final cost estimates to the Board of Review. The Board of Review includes representatives from the Construction Bureau, Road Design Section, Pavement Design Section and Contract Plans Bureau. The Board of Review will review and adjust the major bid item prices as deemed necessary. These items typically may include excavation, aggregate surfacing, plant mix surfacing, asphalt milling, erosion control, mobilization and miscellaneous work. The Contract Plans Bureau will review all other bid prices and prepare the Engineer's Estimate.

Use the following format for showing the cost estimate in the report:

New Structure	$132,000
Remove Structure	$ 10,000
Road Work	$ 82,000
Traffic Control - Detour	$ 77,000
Subtotal	$301,000
Mobilization (12%)*	$ 36,000
Subtotal	**$337,000**
Contingencies (10%)*	$ 34,000
Subtotal	$371,000
Inflation (3% per year x 3 years)	$ 34,000
Total CN:	**$405,000**
CE (15%)*	**$ 61,000**

Cost Estimation Format
Figure 7.1B

7.2 ESTIMATING PROCEDURES

When preparing a detailed cost estimate for the Plan-in-Hand or later estimates, the designer should note the following:

1. Funding Splits. Some projects may have two or more funding sources. For example, where bridges comprise a substantial percentage of the total project, they may be funded separately under their own project coding. For these types of projects, separate cost estimates are required for each funding source based on the quantities within that particular funding source. The separation of quantities for funding splits will be determined during the project development.

2. Estimate Form. The Department has developed two estimating forms that the designer should use to determine the construction cost estimate — a manual form and an electronic form. Desirably, the electronic form will be used. The electronic form was developed using Excel. A copy of this program and instructions on how to use it are provided in each of the design units, or a copy can be obtained from the Road Design Section.

3. Quantities. Show all project quantity estimates on the Summary Sheets within the contract plans. Some estimate items maybe shown as information purposes only. Do not include these items in the cost estimate. Those totals from the appropriate summary frames are used in determining the cost estimate. Note that some summary frame totals are added to other frames (e.g., Additional Surfacing Frame totals are added to the Surfacing Frame). Therefore, the designer must be careful not to double count these quantities. Some items may have quantities shown in more than one frame. Combine these quantities when computing the cost estimate. See Chapter Five for information on how to develop quantity summaries.

4. Unit Prices. List the quantity items from the Summary Sheets and the appropriate average bid unit prices on the estimate form. The Contract Plans Section provides the average bid unit prices twice a year. The designer will then submit the estimate form to the District for their review. The District will incorporate their recommended unit prices on the estimate form. The District's review of similar projects should be used to aid in determining the adjusted unit prices.

5. Inflation Factors. Adjust all estimates by an annual inflation factor. Apply the inflation factor using the following formula:

Adjusted Estimate = (Estimate) x (1+i) n

Where: I = inflation factor The typical inflation factor is 3% (i = 0.03).

n = the number of years from the time the estimate is prepared to midpoint of construction (consider the potential for project design time slippage), to the project ready date

Pavement preservation – 1 year (2 years for urban settings with ADA work)
Minor rehabilitation – 2 years
Major rehabilitation – 3-4 years
Reconstruction – 5-6 years
Bridge replacement – 4-5 years
Turn bay or spot improvement – 2-4 years

6. Quantity Descriptions. Only use the quantity description as provided in the average bid unit prices for the quantity description on the estimate form.

7. Lump-Sum Items. Desirably, do not use lump-sum items on a project. However, this is not always practical. Where necessary, only use lump-sum bid items where the scope of work for the item is clearly defined and the amount of work has a minimal chance of changing during construction. Section 5.5.1 provides additional information on how to treat lump-sum items. In determining the unit price for lump-sum items, consider the following:

   a. Mobilization. Estimate mobilization using the criteria shown in Figure 7.2A. The mobilization should be adjusted based on input from District construction personnel. The project location, structural work such as bridges and multiple sites can affect the mobilization costs.

   b. Traffic Control. A percentage is used for the preliminary estimates for traffic control until the District in the final estimate establishes quantities for units of traffic control. The final traffic control quantities provided by the District will include separate items for hours of pilot car and hours of flagging. List these items separately on the estimate sheet.

   c. Other Items. Most lump sum bid items can be divided into individual parts for estimating purposes. For example, clearing and grubbing can be divided into the number of hectares cleared or the size and number of trees to be removed. For removal of structures, the cost can be

determined based on the m^2 of structures on other projects. Once the elements have been segregated, the designer uses engineering judgment to determine the appropriate cost for the lump-sum bid item on the project.

8. Contingencies and Construction Engineering. When developing the detailed cost estimate, assume a cost for construction contingencies and construction engineering. Calculate contingencies assuming a percentage of all construction items, including bridge items, traffic control devices, etc. The percentage should decrease as the project develops and the quantities become more certain. Use a 15 percent contingency for the initial estimate. Reduce this percentage for the other preliminary estimates and use a 5 percent contingency for the final estimate. Contingencies are not to be used to account for inflation.

   Calculate construction engineering based on the criteria shown in Figure 7.2A. The cost of construction engineering can be adjusted based on input from District construction personnel.

9. Approval and Distribution. The design supervisor must approve all construction cost estimates prepared by the designer. A final estimate must be included with the contract documents when the plans are forwarded to the Contract Plans Bureau. Include copies of the cost estimate to those units or individuals as shown in Figure 7.1A and to the project files.

Project Type	**Mobilization**	**Construction Engineering**
Reconstruction	8%	10%
Reconstruction (Eastern MT)	10%	10%
Single project – 2 lane overlay	15%	8%
Multiple project – 2 lane overlay	10%	8%
Interstate overlay	8%	8%
Urban reconstruction	18%	15%
Bridge and approaches	18%	15%
Signal projects	10%	10%

Mobilization and Construction Engineering
Suggested Rates
Figure 7.2A