



PRODUCTION BASED CONSTRUCTION COST ESTIMATE

(BOTTOM-UP ESTIMATING METHOD)

DEVELOPED FOR *CONSTRUCTION PLANNING*
DURING THE *DESIGN PHASE*

REV2 – 10-JAN-14

CONTENT

1	BOTTOM UP ESTIMATING – SUMMARY FOR DESIGN TEAM	3
1.1	IMPORTANT LUMP SUM PRICING CONSIDERATIONS	3
1.2	CONSTRUCTION COST ESTIMATE NARRATIVE	4
1.3	ESTIMATOR WORKING WITH THE DESIGN TEAM	5
1.4	ESTIMATING QUALITY ASSURANCE CONSIDERATIONS.....	5
1.5	EXAMPLE ‘BOTTOM UP’ ESTIMATE	7

1 BOTTOM UP ESTIMATING – SUMMARY FOR DESIGN TEAM

The *Production Based Estimating* approach is often referred to as ‘**bottom-up**’ cost estimating. This construction cost estimating methodology is more effective than traditional unit price estimating because estimates are developed based on the way that the project will be constructed rather than merely applying unit prices to quantity take-offs.

Bottom-Up Estimating is required for all projects that are in the criteria listed in **SECTION 400 – 427 Bottom-Up Estimate and Reconciliation and this specific requirement applies mainly to projects with significant LUMP SUM costs/items.**

Bottom-Up Cost Estimating:

- ▶ Helps the project team prepare a buildable/constructible approach (to avoid significant concerns/changes during construction).
- ▶ Involves developing costs for the crews, equipment, and production rates that a contractor would use in constructing the project, and developing the estimate based on this information.
- ▶ Helps to capture/resolve constructability issues to optimize the contractor bid price (risk reduction) and construction performance.
- ▶ Helps to prepare a comprehensive planning schedule – significant time related dependencies can be translated into a project construction schedule from the detailed cost estimate.

This early linking of planning to project cost estimating fosters effective cost and schedule control throughout the life of the project and helps to avoid claims and delays.

For all common unit priced elements (other than the Lump Sum Bridge), MassDOT has implemented a “Weighted Average” unit price tracking program. This WABP system has allowed MassDOT and Designers to estimate unit priced items (usually amounting to < 40% of the contract value) more easily. Because of the consistency noted by MassDOT over the past years, Weighted Average program will continue to be utilized for all standard unit price items on MassDOT roadway and bridge projects. Designers (and the independent estimators) will continue to be required to perform quantity development and validation of these unit prices as part the estimate submissions.

1.1 IMPORTANT PRICING CONSIDERATIONS

All Bottom-Up estimates for Lump Sum items shall contain appropriate markups for indirect costs including home office overhead, profit and insurance (special coverage such as pollution, marine, and other unique job requirements) and bonds. All estimates should exclude escalation from the Items as MassDOT will apply this programmatically. Time and care must also be taken to develop, overhead costs, general conditions costs, and profit rates in a sound, logical manner, rather than by applying blanket percentages and should be done so in a manner that does not duplicate mark-ups already applied to the historical unit prices used in the estimate (if applicable). Prices at the detail level for material, equipment, and labor must reflect local/industry pricing to the maximum extent possible.

Labor pricing shall be current and shall incorporate:

- ▶ Appropriate Prevailing Wage rates and fixed fringes for the local area;

- ▶ Variable fringe/burden calculations based on assumption of hours per working year or years of retention (e.g. holidays and vacation for some Union trades);
- ▶ Workers compensation rates;
- ▶ Appropriate payroll taxes and insurances (Federal and State Income tax; Social Security; Medicare; Mass. Health; etc); and
- ▶ Assumed contractor healthcare and vacation benefits.

Pricing of overtime and shift work shall reflect appropriate local labor wage premiums and appropriate calculation of payroll taxes and burdens above. This will be evaluated as part of the 75% (or 100%) submission, following the completion of a detailed Contract Time Determination study (i.e. detailed construction schedule) that utilizes information from the construction cost estimate.

The Designer Estimator should be mindful of not applying duplicative mark-ups to the components of the cost estimate that are Unit Priced (not Lump Sum) – as the Weighted Average Unit Price data base likely already includes mark-ups. On the other hand, the Estimator should be mindful and account the pricing base (date) of those unit prices.

All construction ‘Bottom Up’ cost estimates, provide by the Designer, are not to include *design phase contingency* of any type embedded into the payment items. MassDOT will formulate escalation and design phase contingency to account for: the lack of scoping detail; changes to the scope that will inevitably occur as design progresses; known and unknown project risk factors; and market fluctuations that will occur over the life of the project. However, the Designer is asked to identify what aspects of the quantity development are considered to be quantity contingency (because the scope has not fully evolved yet).

1.2 CONSTRUCTION COST ESTIMATE NARRATIVE

For all projects requiring a Bottom’s Up Construction Cost Estimate, the Designer is required submit a detailed narrative providing all of the relevant basis and assumptions used to produce the pricing for all applicable Lump Sum items.

The estimate narrative should list the following:

- ▶ List the specific project documents and source documents forming the basis of estimated scopes and assumptions. Identify sources and dates.
- ▶ Identify all scopes, quantities, and costs, provided by sources other than the estimating team (e.g. ‘pass-through’ allowances provided by the MassDOT (including MBTA), the Designer, or third party)
- ▶ Reconcile major scope changes from prior estimates, as identified by the design team.
- ▶ Reconcile summary level cost variances from prior estimate, in tabular or narrative form.
- ▶ Reference, and explain, detailed estimate ‘backup’ such that third party readers can correlate summary level information with the backup.
- ▶ Outline unresolved scope or cost issues.
- ▶ Verify that the Project Utilities Coordination Form (PUC) has been provided and utilized.
- ▶ Describe concerns, approach, and documents used to formulate the estimate for all sub-surface work.

- ▶ Describe and constructability concerns that were developed during the estimate that MassDOT Construction should be made aware of. And identify what actions are being taken by the Designer to resolve them.
- ▶ Describe estimate departures from project documents, and why they are included (e.g. constructability).
- ▶ Describe estimate assumptions regarding site access restraints.
- ▶ Describe estimate assumptions regarding sequence of work and labor shifts.
- ▶ Describe the specific estimating methodologies employed- e.g. parametric; detailed; quoted; historical, or other sources.
- ▶ Describe the basis of material cost development, labor cost development, equipment cost development, markups development.
- ▶ Describe the basis and levels of project markups-level of overhead, profit, and soft costs applied, with justification.
- ▶ Describe contingencies applied and how they were developed (if any).
- ▶ Describe escalation markup applied to bottom line (if any).
- ▶ Outline major project risks that may significantly impact project costs.
- ▶ Where formal, or informal, risk analysis has been employed, outline how it has been used in development of the cost estimate.

1.3 ESTIMATOR WORKING WITH THE DESIGN TEAM

The professional estimator is established as an extension of MassDOT’s support to help to ensure that project design is likely to meet construction budget expectations. Whereas each design professional in the team may work on a subset of the project scope, the estimators must become familiar with all content in all documents, and will need to frequently be involved in the evolution of the design stage. Developing estimates with the mindset of developing a bid estimate will allow the estimator to produce valuable feedback to the Designer and MassDOT (through the Designer PM) regarding final document clarity, accuracy, bidability, and constructability.

The level of detail of the assumptions will vary from project to project, but the estimator shall discuss and validate all assumptions with the project design team.

1.4 ESTIMATING QUALITY ASSURANCE CONSIDERATIONS

The Designer is required to provide quality assurance for the development of their submission documents. The following are some recommendations for those aspects for the Designer to QA (of estimate) and will vary depending upon the project complexity.

- Check to see that all scope elements are included in the estimate.

- Check to see if the estimate is in the required format. Estimate Format Review correspondence and other documentation provided by the estimator which identifies the required format that the estimate is to be presented in, e.g. CSI, bid item numbers, Unifomat, etc.
- Review the summary level pricing represented by the overall estimate, if feasible. For example, check the overall square foot price of the estimate and compare it with pricing of similar bridge projects using the most pertinent pricing source available, e.g., historic project pricing, or estimating manuals.
- Review the estimator's take-off files to ensure the accuracy of quantities derived by the estimator. At a minimum, check quantities of major scope items comprising the majority of the cost of the project. Ensure that quantity take-off documentation is included in the estimate file prepared by the estimator and utilized the current documents.
- Ensure that backup documentation is included in the estimate file prepared by the estimator for all items of material. Backup documentation may include vendor quotes, historic pricing from other recent estimates, photocopies of pages from estimating manuals, copies of recent invoices, or other pertinent substantiation.
- Ensure that backup documentation is included in the estimate file prepared by the estimator for all equipment. Backup documentation may include vendor quotes, historic pricing from other recent estimates, photocopies of pages from estimating manuals, copies of recent invoices or lease agreements, or other pertinent substantiation.
- Ensure that backup documentation is included in the estimate file prepared by the estimator for all labor. Backup documentation should include prevailing wage agreements in the vicinity of the project and other pertinent information. If appropriate, check to see that the backup includes a workup of the elements comprising the fully burdened wage rate.
- Check to see that overhead and profit have been included in the estimate. Check to see that the overhead and profit rates used are appropriate for the project. Ensure that the estimate file prepared by the estimator contains a discussion/workup of overhead and profit rates used.
- The Estimate QA Reviewer shall document all questionable cost elements identified during the review by red-lining the estimate, or other suitable means. The Reviewer shall then discuss the review, including all questionable cost elements, with the estimator. The estimator shall make adjustments to the estimate based on the comments provided by the Reviewer, and shall provide a copy of the adjusted estimate to the Reviewer. The Reviewer shall perform a final QA review of the estimate to ensure that all adjustments discussed with the estimator have been incorporated into the estimate.

1.5 EXAMPLE 'BOTTOM UP' ESTIMATE

Example of the details provided in the **production based cost estimate** for the direct cost elements (*i.e. those costs that are directly attributable to a particular operation – excluding indirect costs that are often shared between many operations, such as the field office costs*). This example is shown in HCSS Software. Timberline and Excel Spreadsheets are also commonly used to satisfy the production based estimating approach.

EXAMPLE DIRECT COST ESTIMATE FORMAT

Activity Resource	Desc	Pcs	Quantity Unit	Unit Cost	Perm Labor	Constr Material	Equip Mat/Exp	Sub-Ment Contract	Total
BID ITEM = 700		CLIENT# = 945.204							
Description = APPROACH LAND: 8-EA, DIA-5.0'			Unit = LF		Takeoff Quan:	150.000	Engr Quan:	150.000	
2	MATERIALS		150.00 LF	125.000		19,406			19,406
8CR25T	Hydraulic Crane, 25 To	1.00	177.27 HR	101.720			18,663		18,663
8MDRTM	Drill Rig Track-Mounte	1.00	177.27 HR	330.000			60,547		60,547
8SUCHOSE	20' Suction Hose, 2"	1.00	177.27 HR	0.270			50		50
8WDH6	50' Discharge Hose 6"	1.00	177.27 HR	1.660			305		305
8WP6	Cent. Water Pump 6"	1.00	177.27 HR	40.000			7,339		7,339
LABFM	Labor Foreman	1.00	177.27 MH	54.010	14,156				14,156
LABOR	Laborer	3.00	531.82 MH	51.600	40,377				40,377
OPCR	Crane Operator	2.00	354.55 MH	50.100	26,261				26,261
OPEO	Equipment Operator (Light)	1.00	177.27 MH	50.100	13,130				13,130
OPOIL	Oiler	2.00	354.55 MH	50.100	26,261				26,261
PDD	Pile Driver	2.00	354.55 MH	65.320	34,098				34,098
\$260,592.18		13.0000 MH/LF	1,950.01 MH	[721.62]	154,283	19,406		86,903	260,592
0.8462 Units/Hr		6.7693 Un/Shift	0.0769 Unit/MH		1,028.56	129.38		579.35	1,737.28
====> Item Totals:		700	- APPROACH LAND: 8-EA, DIA-5.0'						
\$260,592.18		13.0000 MH/LF	1,950.01 MH	[721.62]	154,283	19,406		86,903	260,592
1,737.281		150 LF			1,028.56	129.38		579.35	1,737.28

HCSS SOFTWARE

Estimate components expected:

- Bid Item or cost group
- Quantity (Unit to be measured and installed)
- Description of item being priced
- Coding for labor and equipment
- Crew size/composition
- Material costs / unit – with breakdown of all materials (described) required for the operation (not shown above for simplicity) – shown as temporary or permanent.
- Production rate – MH/Unit, Unit/MH, Unit/Shift, Unit/Hr.
- Sub-Totals – for all labor material and equipment.