Majors Program

Cost Estimating Software

User Manual

Created by the Construction and Materials Support Center at the University of Wisconsin-Madison

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Contents

Introduction

Intentions of the Software

Reliable and accurate cost estimates are critical to a successful highway improvement program. This is particularly true for the Wisconsin Department of Transportation (WisDOT) Major Highway Program where cost overruns have significant impacts and consequences on other projects in the program. An emphasis and priority for The Majors Program is to focus on estimating, managing and controlling costs of projects. Since projects in the Majors Program must be enumerated by the Legislature and Governor, the total project cost must be estimated, not just the construction or let costs. This estimating process occurs very early in the project development process when cost estimates are most difficult since relatively few project design details have been finalized and many assumptions still form the basis of the estimate.

The Cost Estimating Software was developed to assist in preparing accurate total project cost estimates. It is anticipated that the tool will be used throughout a project's evolution, especially at the conceptual stage, and then again for the final environmental document estimate (20% to 30% design). It is this EIS estimate that will then also be used when the project is submitted to the TPC for enumeration. Accurate conceptual estimates are critical because they are the basis on which funding decisions are made and they form the baseline budget to which all future costs are managed against. The approach is based upon a combination of historical bid data for major roadway items whose quantities can be estimated early in the development process and historical percentage for other major components of the project through allowance and contingency factors.

The Cost Estimating Software was created to provide statewide uniformity and consistency in the estimating process and in communicating the results. It also provides a method for allocating project costs over the full project development and delivery timeframe. Additionally it provides a format for documenting the basis of the estimate, the assumptions made and calculations done. It also can be used to track the cost impacts from changes that are made to the project throughout the development process. This software is designed to allow the estimator to develop the project estimate in a systematic step by step manner. It is not, however, a manual on how to do basic cost estimating for highway projects. The flowchart shown in Figure 1 describes the overall methodology and process for developing the estimate and a brief description of each step in the process follows:

> ***Step 1 - Project Information, Scope, Location and Site Characteristics:*** This step involves gathering information about the project, including the location, length, type of project, scope details, design parameters and broad design assumptions upon which the estimate is based.

> ***Step 2 - Major Roadway Quantities:*** At 30% design complete, proposed roadway alignment and structural sections allow the determination of major roadway quantities with reasonable accuracy. Such quantities include earthwork, pavement, base and sub-base, barrier wall, curb and gutter, and pavement removal.

Step 3 - Major Roadway Item Cost Estimate: The Major Roadway Item Cost Estimate is produced by multiplying the calculated major roadway item quantities times estimated unit costs. Estimated unit costs are based on past bid prices obtained from historical databases and adjusted as needed based upon project conditions.

Step 4 - Allowance Factors: Allowance Factors are used to estimate the cost of a group or collection of items whose quantities are not sufficiently detailed at this stage for unit price cost estimating. Allowance percentages are multiplied times the Major Roadway Item subtotal cost to produce the allowance items costs. The allowance percentages are predetermined and input automatically based upon the project type and the degree of certainty selected

Step 5 - Specialty Construction Costs: When historical data or historic bid cost based procedures exist, construction costs for specific items unique to the individual project are estimated using parametric methods.   Parametric methods, for example, can be used when cost data is available for square footage of bridges, square footage of retaining walls, sign bridges, and signalized intersections.   When historical costs do not exist, costs are estimated using a cost based system where a contractor's labor, equipment, materials, overhead and profit are estimated for completing the work.

Step 6 - Base Construction Cost Estimate: The Base Construction Cost Estimate (BCCE) is the sum of the subtotals obtained from steps 3 to 5, and represents the estimate for the construction cost of the project.

Step 7 – Apply Scope Change and Delivery Allowance Items: When preparing estimates at this stage of the development process there are uncertainties as to final scope, design changes, influence of community interests, site conditions, construction methods, etc. The Scope Change Allowance is calculated as a percentage of the calculated BCCE, and then Scope Change Allowance and BCCE are added up to give the Estimated Contract Let Amount (ECLA). The other allowances are estimated by a markup that is applied to the ECLA and are calculated by multiplying allowance factors times the ECLA. The allowance percentages are predetermined and input automatically based upon the project type selected in Step 1.

Step 8 - External Costs: External costs are those that compensate third parties for project impacts. Real estate, cost of relocating utilities, and Jurisdictional Transfer cost are the most common items. Real estate costs should include costs for acquisition, easements, relocation, demolition and administration. These costs are estimated using guidance provided in the Real Estate Manual.

Step 9 - Base Project Cost Estimate: The Base Project Cost Estimate is the sum of the subtotals obtained from the previous steps, and represents the total cost of the project as developed by the design team prior to the project risk analysis being performed.

Step 10 - Project Risk Evaluation: The project risk evaluation consists of two parts; (1) an independent, systematic review and validation of the base cost estimate, and (2) a risk

assessment to identify risks that could drive up project costs. The process examines how risks can be lowered and cost vulnerabilities managed. Different cost risks are identified and an assessment is made as to the likelihood of the risk occurring and the impact of the risk should it occur. Adjustments are then made to the cost estimate based upon recommendations given in order to account for the potential project risks.

Step 11 - Apply Risk Adjustments: Cost estimates for risks identified during the risk evaluation workshop are recorded and summed to provide a subtotal of how the various risks impact the total estimate.

Step 12 – Current Year Total Project Cost Estimate: The risk item total is added to the Base Project Cost Estimate to give the Current Year Total Project Cost Estimate.

Step 13 – Apply Inflation Factors: Separate inflation factors can be selected for design, construction and real estate. These inflation factors are then applied to the respective portions of the total cost (design, construction, real estate), and then the three parts are added together to provide a cost estimate for each year of the planned expenditure.

Step 14 - Conceptual Total Cost Estimate: The Conceptual Total Cost Estimate is the total cost of the project that can reasonably be expected if the project materializes and is delivered as planned.

Step 15 - Analyze Construction Bids and Project Costs: As additional construction projects are completed, the unit costs for major roadway items need to be included in the historical bid databases so that future cost estimates reflect the most current cost information. Bid costs also need to be broken down for the various allowance categories and the allowance factors updated. At the conclusion of a project, actual total project costs need to be analyzed through a feedback loop in order to reevaluate allowance factors. This analysis will allow the prognostic accuracy of this tool to improve over time and better reflect actual project history. This, in turn, will improve the cost estimating process.
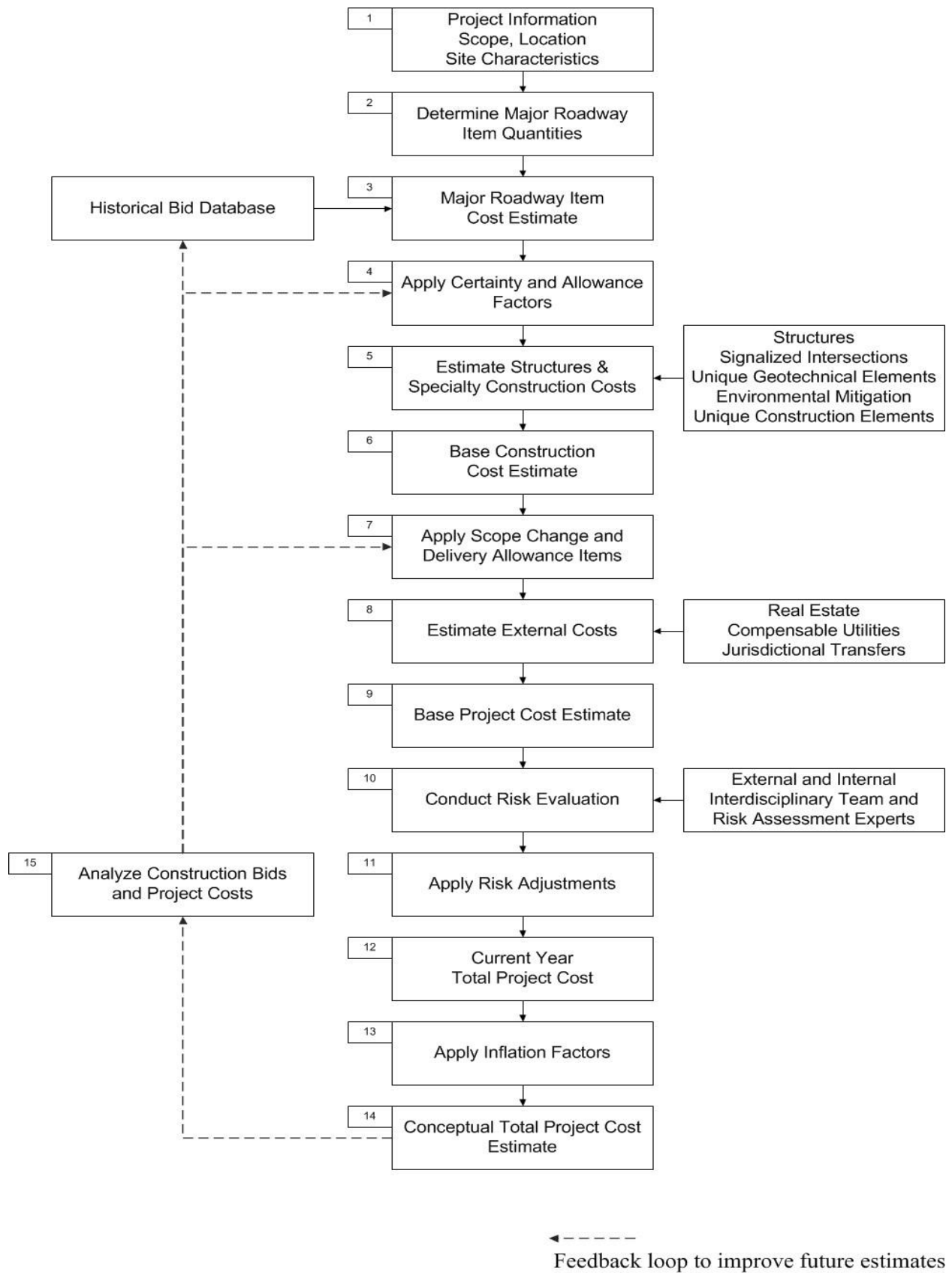
Figure 1: Cost Estimating Flowchart

Scope of the Manual

This manual is intended for use by the estimator when forming a conceptual estimate at or before the 30% design complete stage in the project. Once the conceptual estimate has been reported to the Transportation Projects Commission (TPC), the estimate should be saved and no longer changed.

This manual is meant to facilitate the creation of an accurate estimate of project costs through use of a systematic process and spreadsheet to capture quantities, unit prices and lump sum amounts known at the conceptual stage of the project. The software will use these numbers to generate a total project cost estimate and then report them out in a format for submittal to the Bureau of State Highway Programs. The manual also provides definitions of the quantities to be estimated to help the user understand where certain materials should be accounted for in the software program. Though the definitions are available as a guide, the estimator should understand the estimating process in sufficient detail to ensure that items are only accounted for once and that double counting does not occur.

Instructions for updating the software or for conducting a risk assessment are <u>not</u> included here. If you are interested in updating the software program, see the "Estimating Software *Update* Manual".

Estimating Instructions

1. Project Information

    a. Open the "Estimator Spreadsheet" excel file.

    b. In rows 2 through 5, provide the Project I.D., Highway, Project Title, and Project Limits in the designated areas.
        Note: The Project Title should be consistent with that shown on the Project Summary Screen in FIIPS.

    c. In rows 6 and 7, there are three dropdown menus shown below.

Dropdown Menus

i. In the Project Type menu, choose rural, suburban, urban, or rural/suburban. For a description of each choice, hover your mouse over the cell that says Project Type and a description will appear as shown below.
**Note: Similar comments with information about the cell will appear when hovering over any cell with a red triangle in the top, right corner.

ii. Choose Gentle, Moderate, or Severe in the Topography dropdown menu. Descriptions of the choices can be found by hovering over the cell that says Topography. Select the terrain type that generally describes the overall project.

iii. Choose Course-grained or Fine-grained in the Soil Type dropdown menu. Descriptions of the choices can be found by hovering over the cell that says

Soil Type. Select the soil type that generally describes the overall project soil type.

    iv.   The Project Duration box should be left alone. It will automatically fill in when dates are entered later in the program.

d.   Rows 8 and 9 require key dates.

    i.   **Current Year:** The current year tells the program for which year the unit costs are calculated. If at any point in time the current year is changed, all unit prices must be updated to reflect the change and the costs expected in this new "current year".
**Note: It is the responsibility of the estimator to bring unit costs to the correct year. This can be done using Construction Cost Indexes (CCI), inflation rates, or other methods.

    ii.   **Start Preliminary Design/Start Construction/End Construction:** These dates should be entered as the four-digit fiscal year only (e.g. 2018). Do NOT enter a month or day.

e.   In Rows 10 and 11, there are cells titled Project Scope and Project Assumptions. Clicking on these cells will take you to a separate tab that allows you to input details specific to the estimate. Fill these in by following the description in the comment box, visible when you hover over the title cell.
****Note: These tabs are very important because they describe exactly what is being estimated. The more explicit you are in these tabs, the easier it will be to understand and review your estimate.**
 The scope statement should be in sufficient detail to identify what work is to be done and what is not to be done. Topics such as the project limits, number of lanes, locations of interchanges, bike and pedestrian accommodations, utility relocations, railroad issues, access and frontage road considerations, level of Community Sensitive Design (CSD) effort are things that should be documented in the project scope. A well defined scope also provides a means for evaluating the impact of any proposed scope changes. The assumptions made in developing the conceptual estimate also need to be identified and documented so that they can be conveyed to others working on the project and to those who may review and update the cost estimate. A good guide is provided in the Facilities Development Project Scoping Document: http://roadwaystandards.dot.wi.gov/standards/fdm/03-05-003att.pdf. Assumptions made for developing cost estimates for major roadway items, structures, and special construction items are to be documented on spreadsheets for those items. Major corridor assumptions such as the corridor alignment option, types of interchanges,

inclusion of ITS/FTMS, locations of major bridges, etc. should be documented here to provide an overview of what is the basis of the conceptual estimate.

f. Click the green Program tab along the bottom of the screen (see figure below) to get back to the main worksheet.
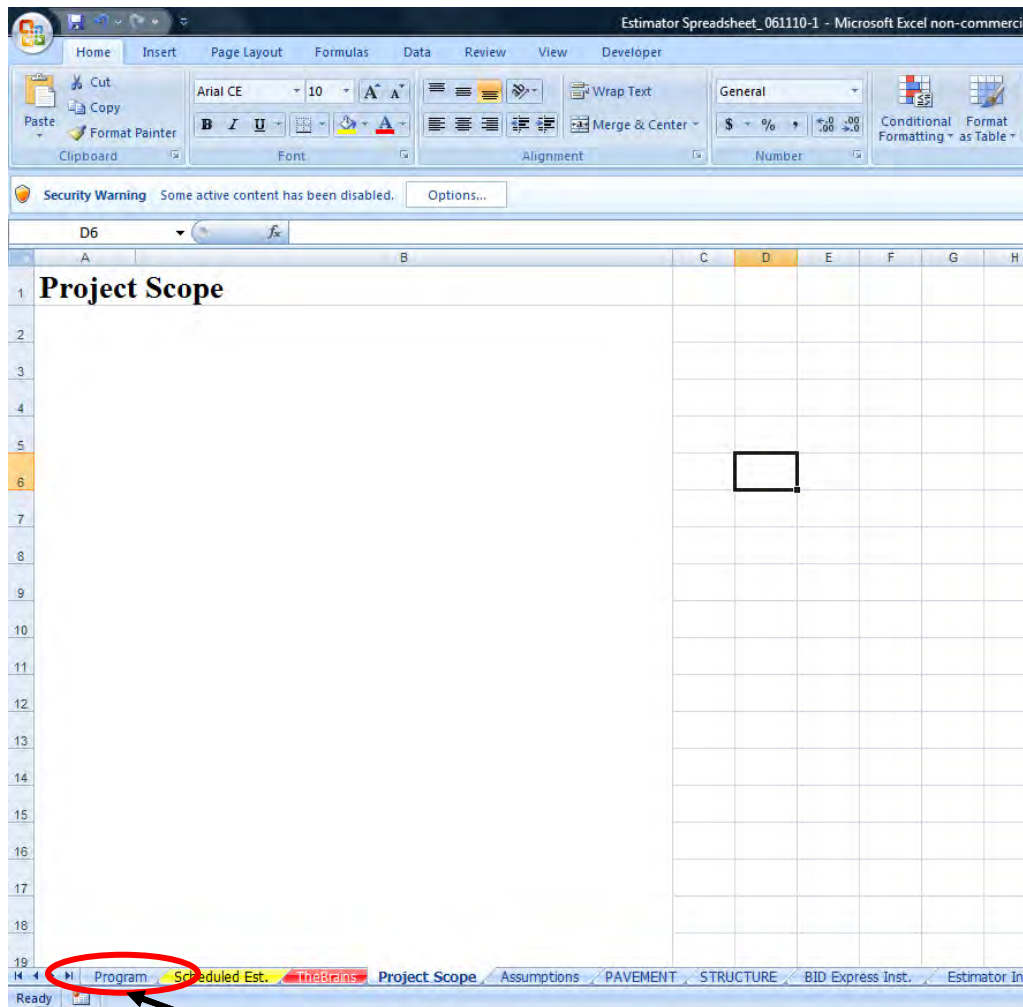
Program Tab

g. In Row 10, to the right of Project Scope, there is an input cell for Alternative #. This cell can be used if you are comparing alternatives for which the Project Scope and/or Assumptions differ. If multiple alternatives exist, number each and highlight any differences in the Scope or Assumptions sections.

Estimating Major Roadway Quantities and Costs

A historical bid-based approach is used to estimate the costs of the Major Roadway Items. With this approach historical unit costs are applied to units of work for the Major Roadway Items to determine a total cost for the specific item. The unit cost data to be used for this estimate can be gotten from a variety of sources where bid prices from prior WisDOT projects are gathered and summarized. These prices should then be modified or adjusted to reflect current prices (inflated to current time) and project conditions. Sources of historical cost data include:

- Bid tabs from similar projects
- Regional historical databases
- Statewide Average Unit Price List
- Trns*port Estimator
- Bid Express

It is recommended that the project design team utilize either Trns*port Estimator or Bid Express as a starting point to develop the unit prices and then verify the price by comparing it to one of the other referenced data sources. The Wisconsin Construction Cost Index provides another source of information for examining trends and adjusting costs to the current year.

The Trans*port Estimator software uses statistical methods to generate unit item prices from the historical bid tabs that are updated quarterly by WisDOT. The factors that are accounted for in the software generated prices are: county, location, time of year, and quantity. The graphical relationship of price and quantity available in Estimator allows the user to view the volatility of each item and that can be useful for adjusting the unit prices. One of the drawbacks to this tool, however, is that the user is unable to view the number of data points or the types of projects used in the statistical model.

Bid Express is a commercial product that provides a searchable database of WisDOT bid tabs through an online website. The database is updated monthly and maintained by an external company. The web based database allows users to sort and search for item prices by name, item number, county, quantity, price, contract ID, and letting date.

The drawback to using this data source is that project descriptions are not included in the database and knowledge of past projects is needed if the user wants to identify items from projects with similar construction characteristics. A review of past project Ads can help in locating similar projects and project ID's.

The Statewide Average Unit Price List contains 3-years of average unit prices for standard bid items. The average unit price is based upon all projects using the item on contracts let in the fiscal year. This information is available on WisDOT HCCI website at http://roadwaystandards.dot.wi.gov/hcci/bid-letting/index.shtm.

2. Pavement Worksheet

The next step in estimating a project is to fill in the pavement worksheet. To view the pavement worksheet, click on the pavement tab at the bottom of the workbook as shown below.
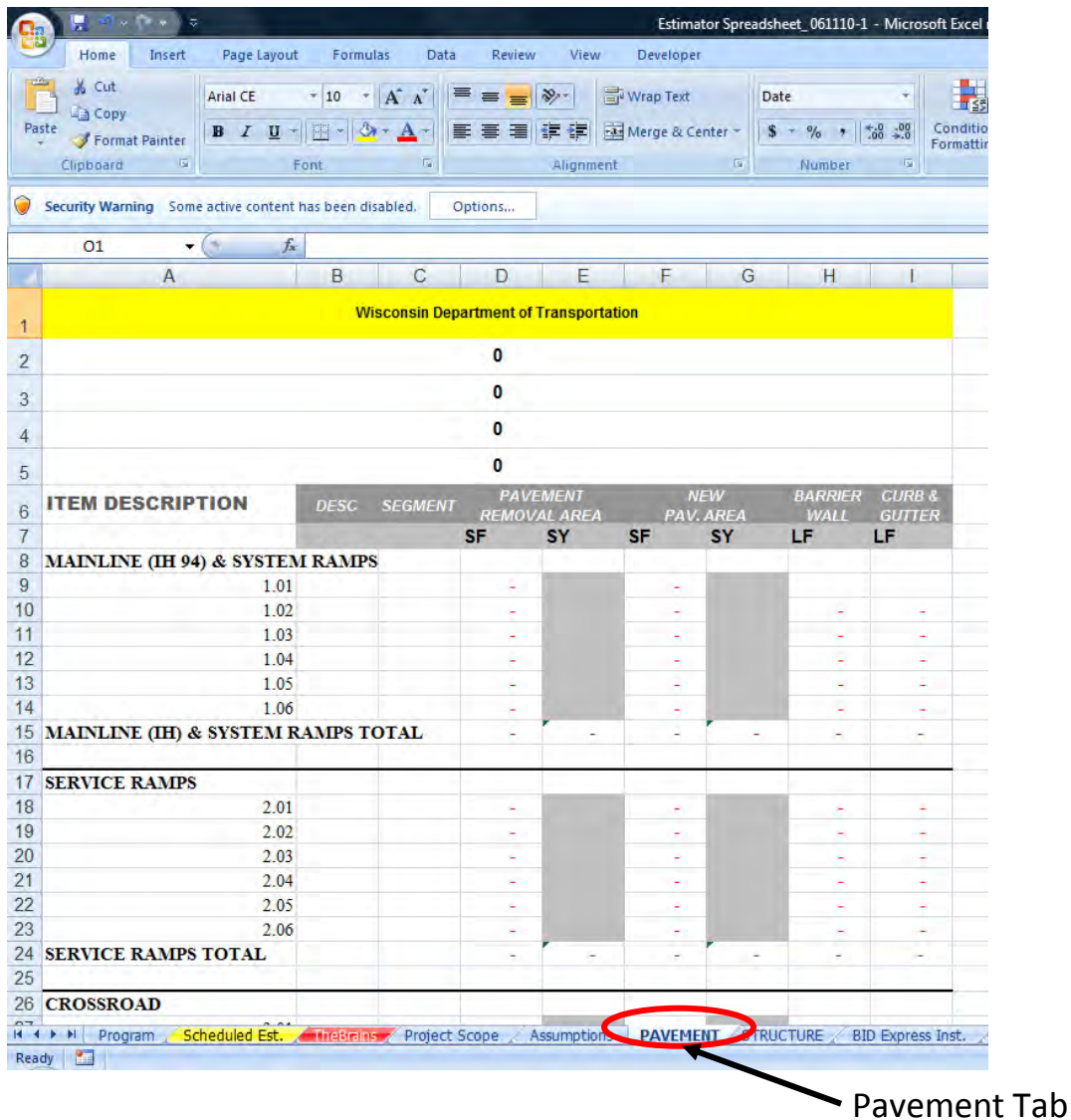

Pavement Tab

Figure 5

Preliminary design data should be used to fill in the pavement tables on the worksheet.

Filling in the pavement worksheet:

a. Lines 2, 3, 4, and 5 will fill in automatically once project information is entered into the program sheet.

b. In the pavement tables, there is space to provide pavement information for the mainline, system ramps, service ramps, crossroads, frontage roads, and local roads.

Break each of these sections into logical segments. Provide a description and segment title for each.

c. For each segment, include expected square footage of pavement removal and new pavement and linear footage of barrier wall and curb & gutter. Quantities for alternate routes, permanent pavement on detour routes, and other permanent upgrades done for the project need to be included in these quantities as well. For a description of what to include with each item, either hover over the item name on the pavement worksheet or see the definitions table in Appendix A.

**Note: Appendix A provides a description of items to be included in each quantity. Do not include Jurisdictional Transfers in the pavement worksheet. There is a separate worksheet for JT costs.

3. Structures Worksheet

The structures worksheet should be filled in to provide the program with the expected structural quantities. To view the structures worksheet, click on the structures tab at the bottom of the workbook as shown below.
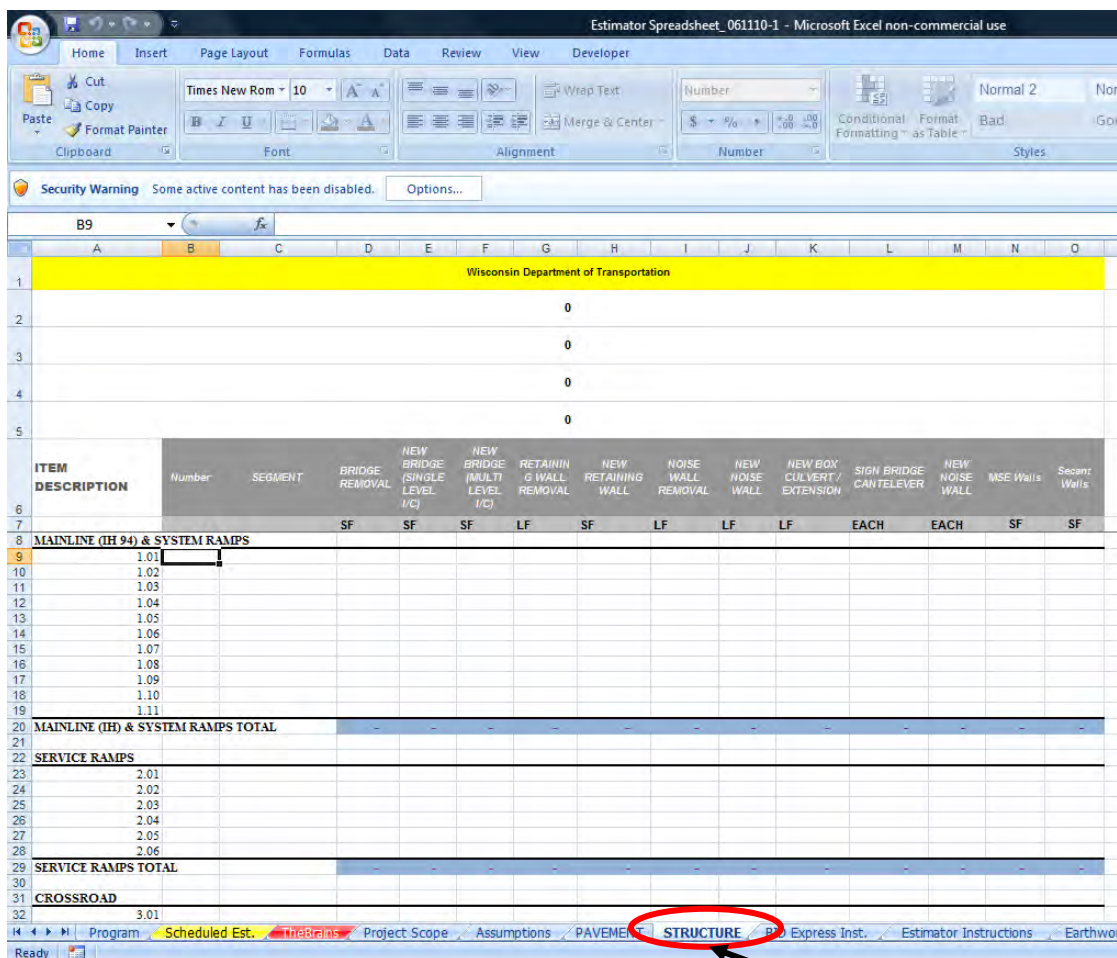
Figure 5

Structure Tab

Filling out the structure worksheet:

a. Like in the pavement worksheet, lines 2, 3, 4, and 5 will fill in automatically once project information is entered into the program sheet, and there is space to provide structure information for the mainline, system ramps, service ramps, crossroads, frontage roads, and local roads.

b. Break each of these sections into logical segments. Provide a description and segment title for each.

c. For each segment, include expected square footage or linear footage of bridge removal, new bridge (single and multi level), new retaining wall, new noise wall, new box culvert, sign bridge cantilever, MSE wall, and secant walls into the appropriate cell. For a description of what to include with each item, either hover over the item name on the structures worksheet or see the definitions table in Appendix A. Historical costs for various types of structures can be found in the LFRD Bridge Manual. (http://on.dot.wi.gov/dtid_bos/extranet/structures/LRFD/LRFDManualIndex.htm). Costs are tabulated by square foot of bridge deck and retaining wall face or length of culverts and multiplied times the historical average unit prices. Contact the Bureau of Structures for assistance in developing estimates or for questions regarding unique structures where no historical data exists.

**Note: Appendix A provides a description of items to be included in each quantity. Do not include Jurisdictional Transfers in the structures worksheet. There is a separate worksheet for JT costs.

4. Other Quantities

After completion of the pavement and structures worksheets, many of the required quantities in the Program worksheet will be filled in automatically. However, there are still a few quantities that require user input.

To begin this process, click on the green Program tab.

Filling in other quantities:

a. Under Major Roadway Items, the user should provide estimated quantities for Earthwork and Signalized Intersections in the bold-orange spaces.
    i. Earthwork should include all types of excavation (common, marsh, rock,...), borrow, EBS, etc. A worksheet is provided for documenting earthwork quantities under the Earthwork Tab and it is suggested that output from the automated design software package be copied onto this worksheet.
    ii. Signalized intersections should be counted and the total number of intersections entered into the quantity cell. No worksheet tab has been created for signalized intersections however one can be created and added to the file if it is warranted.

	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	Total
12					
13					
14	**MAJOR ROADWAY ITEMS**	Bid Express Inst.	Estimator Inst.		
15	Removing Pavment	Insert	-	$0	$0
16	Barrier Wall	Insert	-	$0	$0
17	Curb & Gutter	Insert	-	$0	$0
18	Earthwork	Insert	-	$0	$0
19	Signalized Intersections	Insert	-	$0	$0
20	Pavement, Base & Subbase				
21	Mainline	Insert	-	$0	$0

Insert earthwork and signalized intersection quantities here

5. Allowance Items

Allowance item costs represent contract items whose quantities are not easily estimated at this point in the design and are therefore estimated automatically by the software as a percentage of the Major Roadway Items cost. All the user must do in this section is selecting an appropriate certainty factor from the dropdown menu shown below.

Certainty Factor Drop-box

			% of MRS		
29					
30	**ALLOWANCE ITEMS**				
31	**Certainty Factor**	95%			
		Insert			
		99%			
		95%			
		90%			
32	DRAINAGE	% of MRS	11%	$0	
33	EROSION CONTROL	% of MRS	8%	$0	
34	LIGHTING	% of MRS	1%	$0	
35	ROADWAY INCIDENTALS	% of MRS	26%	$0	
36	SIGNING/MARKING	% of MRS	3%	$0	
37	TRAFFIC CONTROL & STAGING	% of MRS	4%	$0	
38	ITS/ FTMS	% of MRS	0%	$0	
39					
40	Allowance Subtotal			$0	

When choosing a certainty factor, the user should understand that he or she is choosing the likelihood of overestimating the cost of the project. In general, WisDOT prefers to slightly overestimate projects at the conceptual stage to ensure proper funds are available. The certainty factor allows the user to manipulate the estimate to make it more or less likely that the project will be overestimated. For example, choosing a 95% certainty factor means that 95 out of 100 estimates prepared in this way will be overestimated while choosing a 90% certainty factor means that only 90 out of 100 estimates prepared in this way will be overestimated.

6. Unit Prices

A historical bid-based approach is used to estimate the costs of the Major Roadway Items. The unit cost data to be used for this estimate can be obtained from a variety of sources. **These prices should then be modified or adjusted to reflect current prices (inflated to current time) and project conditions.** Sources of historical cost data include:

- Bid tabs from similar projects
- Regional historical databases

- Statewide Average Unit Price List
- Trns*port Estimator
- Bid Express

It is recommended that the project design team utilize either Trns*port Estimator or Bid Express as a starting point to develop the unit prices and then verify the price by comparing it to one of the other referenced data sources.

Directions for extracting unit costs from these two programs can be found below. To verify your estimate using the Statewide Average Unit Price List go to the WisDOT HCCI website at http://roadwaystandards.dot.wi.gov/hcci/bid-letting/index.shtm.

a. **Using Trns*port Estimator**
    iii.   Open Trns*port Estimator.
    iv.   Click on File, then New.
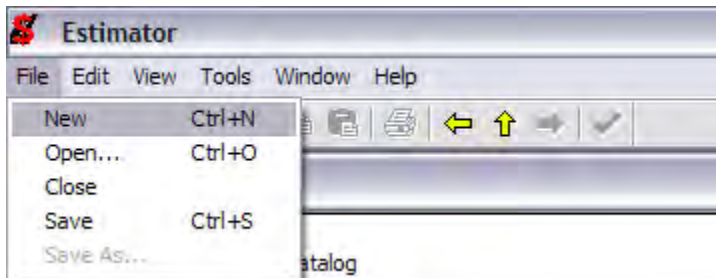
    v.   Fill in your project specifications by entering information or choosing from the dropdown menus provided as shown in the red box below.

Insert Project Specifications

vi. Next, click the + to the left of Estimate on the left portion of the window.

Click +

vii. The word Group will appear under estimate. Click on Group, then click under Line # on the bottom right of the window.

Click Group   Then, click under Line #
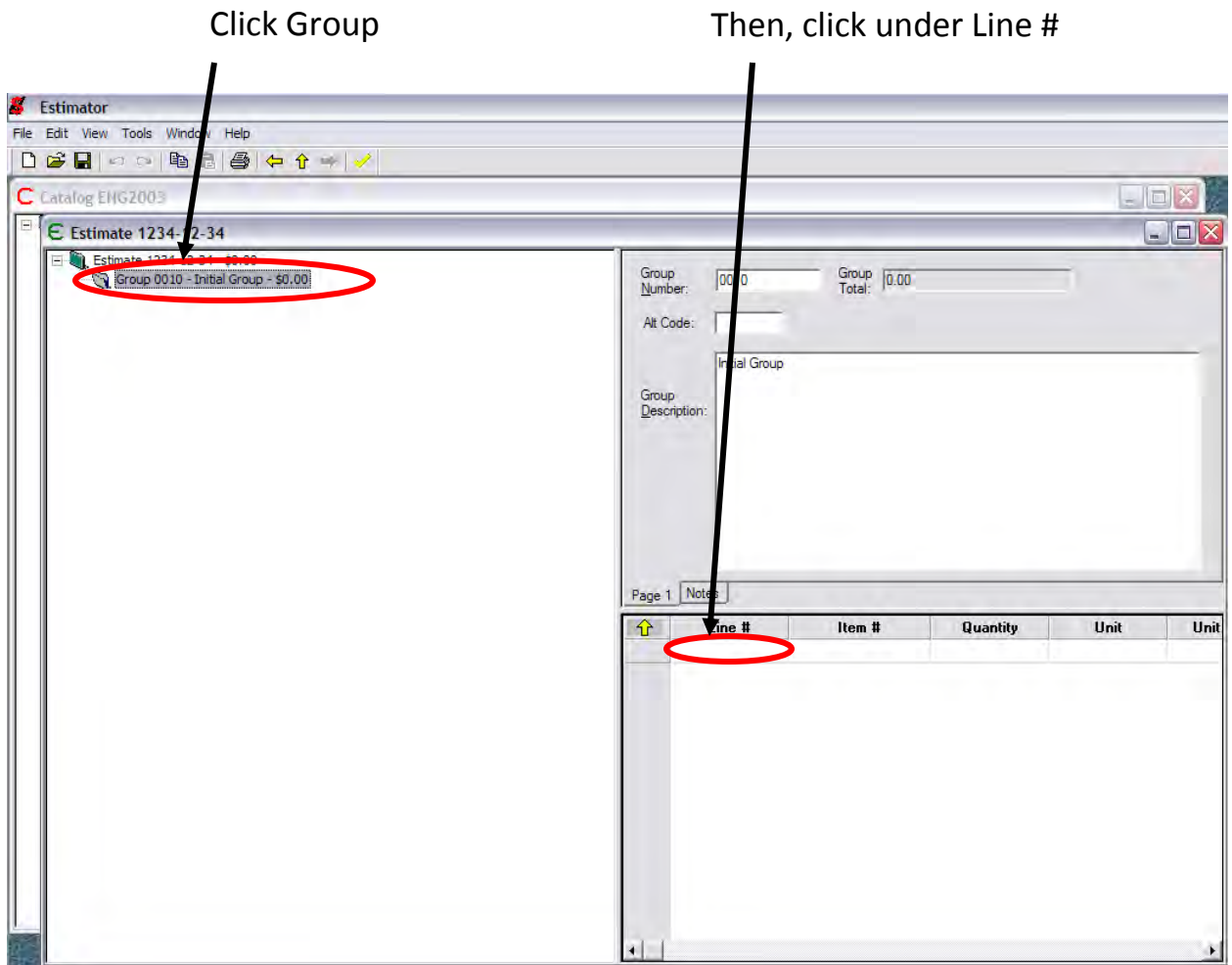
"Item" will appear under Group and a new line will appear in the bottom right box.

Item   New Line
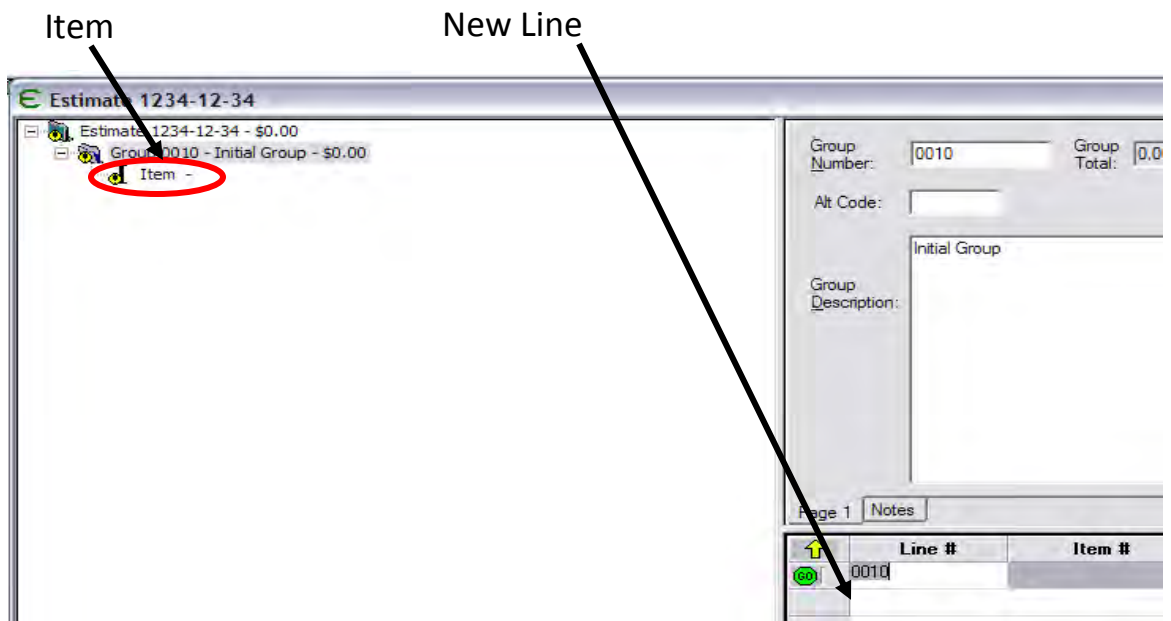
viii. Click on the green "GO" in the lower right box.

Click "GO"

ix. Use the down arrow to scroll through material items by item number and choose the item you wish to estimate.

x. Enter the quantity and choose the correct units using the dropdown menu. Then click in the unit price box. The unit price should be calculated automatically.

Choose Item Number   Enter Quantity   Choose Units

xi. Click on Group and repeat for each item in the Excel "Program" worksheet.

xii. Choose to Print from the file menu.

xiii. Fill the unit prices into the "Program" worksheet in the Estimator Spreadsheet file.

b. Using Bid Express

      i.   Begin by going to www.bidx.com and log in using your username and password and click [Log in] .

www.bidx.com
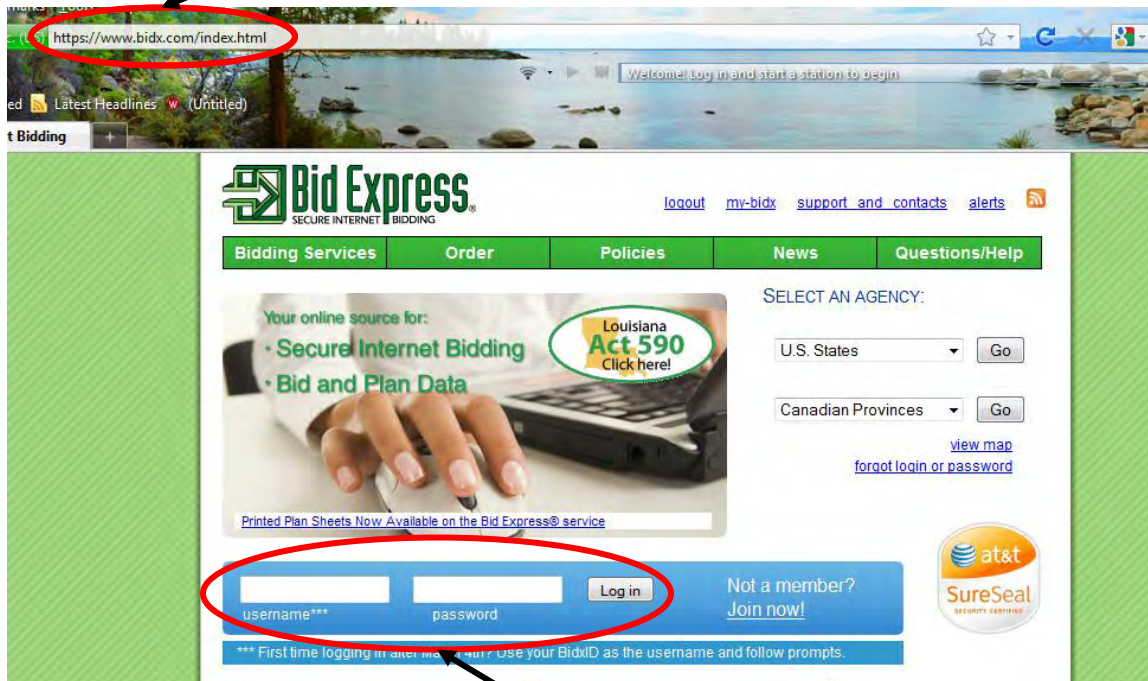
Enter username and password here

    ii.   Choose Wisconsin from the pull down menu on the right and click [Go] .

iii. Once you are on the WIDOT homepage of the bidx website, there are two ways in which you can obtain unit cost information; searching a particular project using the Letting Date or ID number and searching a particular item or contractor.

Searching by Letting Date or ID number:
Click the Lettings tab at the top of the homepage.
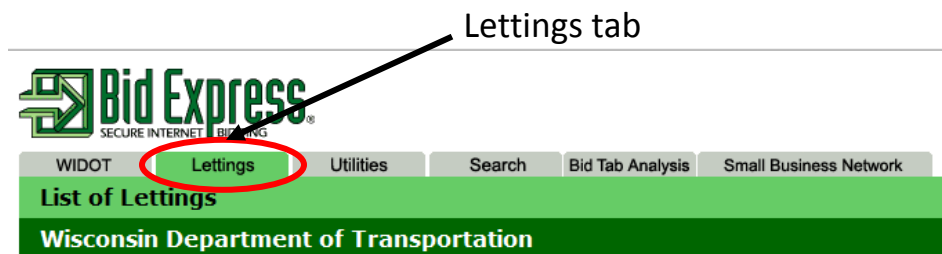
Letting ID	Letting Date	Proposals
• 20110510	May 10th 2011	39
• 20110412	April 12th 2011	40
• 20110315	March 15th 2011	1

From the list of letting dates, click on the date that corresponds to the letting date for the project of interest.

A list of projects let on that date will appear. Click on your project ID number.

Click on the Contract ID

Check to see if the project has similar quantities to the project being estimated. If quantities are relatively close, click "The Bid Tabulations" to see what contractors bid on that item.

Click to see contractor bids

Check for similar quantities

You can choose the bids that appear by checking or un-checking the box next to the contractor's name.

Customize the list of bidders here

From the historical bid prices, make an educated estimate of the unit price for the current project.

Searching by item or contractor:
Choosing the search tab allows you to search Bid Express for a particular item or contractor.

Choose the Search tab

Choose the
Search tab

Enter the item, dates you'd like to search, and sorting options in the Bid
Tabulations Search. Then click Search .

Or search for a contractor in the Vendor Search.

Searching by item will allow you to click on the Contract ID. Clicking this will allow you to search unit cost in the same way as described above in the "Search by Letting Date or Contract ID" section.

7. Special Construction Elements

For items unique to the individual project, like those found in the Special Construction Elements section of the software, cost estimates can be obtained in two ways. If historical data exists, the estimator should determine items costs using cost per square foot data. If there is no historical data to rely on, cost should be estimated using a cost based system where a contractor's labor, equipment, materials, overhead and profit are estimated for completing the work. This should be done for each item unique to the project and entered into the software's Special Construction Elements section.

There are several blank lines so that the estimator can add items. If adding items, be careful that there is no double counting of that item in the estimate.

8. External Costs

External costs are costs that compensate third parties for project impacts such as real estate costs, compensable utilities, and jurisdictional transfers. These costs should be estimated and

entered into the External Costs section of the software. Costs entered here are to include all costs associated with that item. Real Estate costs should be estimated based upon guidance provided in the Real Estate Manual. Jurisdictional Transfer (JT) Costs warrant particular attention and caution to make sure that some of these costs are not accounted for elsewhere in the worksheet and thus double counted. New pavement and pavement removal costs are examples of JT costs that can easily be entered twice .   Separate worksheet tabs may need to be created to identify and document all costs associated with each of these items.

80					
81	**EXTERNAL COSTS**				
82	REAL ESTATE	Insert		$0	$0
83	COMPENSABLE UTILITIES	Insert		$0	$0
84	JURISDICTIONAL TRANSFERS	Insert		$0	$0
85	Other	Insert		$0	$0
86	External Costs Subtotal				$0

There are blank lines available to the estimator to add items. Be sure additional items are not accounted for previously in the estimate.

9. Risk Assessment

The project risk evaluation consists of two parts; (1) an independent, systematic review and validation of the base cost estimate, and (2) a risk assessment to identify risks that could drive up project costs. The process examines how risks can be lowered and cost vulnerabilities managed. Different cost risks are identified and an assessment is made as to the likelihood of the risk occurring and the impact of the risk should it occur. Adjustments should then be made to the cost estimate, in the Risk Adjustment section, based upon recommendations given in order to account for the potential project risks.

89				
90	**RISK ADJUSTMENTS**			
91	Risk Item A	Insert		$0
92	Risk Item B	Insert		$0
93	Risk Item C	Insert		$0
94	Risk Adjustment Subtotal			$0

**Note: The risk assessment may influence the Project Scope Increase Allowance. As a more thorough risk analysis is performed, the uncertainty in project scope will be decreased.   It may be determined as part of the risk assessment that the Project Scope Increase Allowance as a percent of the Base Construction Cost Estimate (BCCE) is too high. In that case, a negative risk adjustment can be included to decrease the estimate or the Project Scope Increase Allowance percentage can be decreased.

10. Adjusting Payout Schedule

There are two ways in which the estimating software can calculate inflation, using the default payout schedule or creating a scheduled estimate. The option that is chosen will depend on the amount of project information related to scheduled costs that is known at the time of the estimate.

This estimating software was developed for use during the conceptual estimating stage, when about 30% of the design is complete. At this point, there is generally limited information about the project. For this reason, the software was developed with a default payout schedule. The default payout schedule was designed to simulate a typical schedule by which costs are incurred by a State Highway Agency (SHA) on a highway construction project. A pictorial representation of the default payout schedule can be seen by choosing the "Diagram" tab and is also shown below.

Diagram Tab
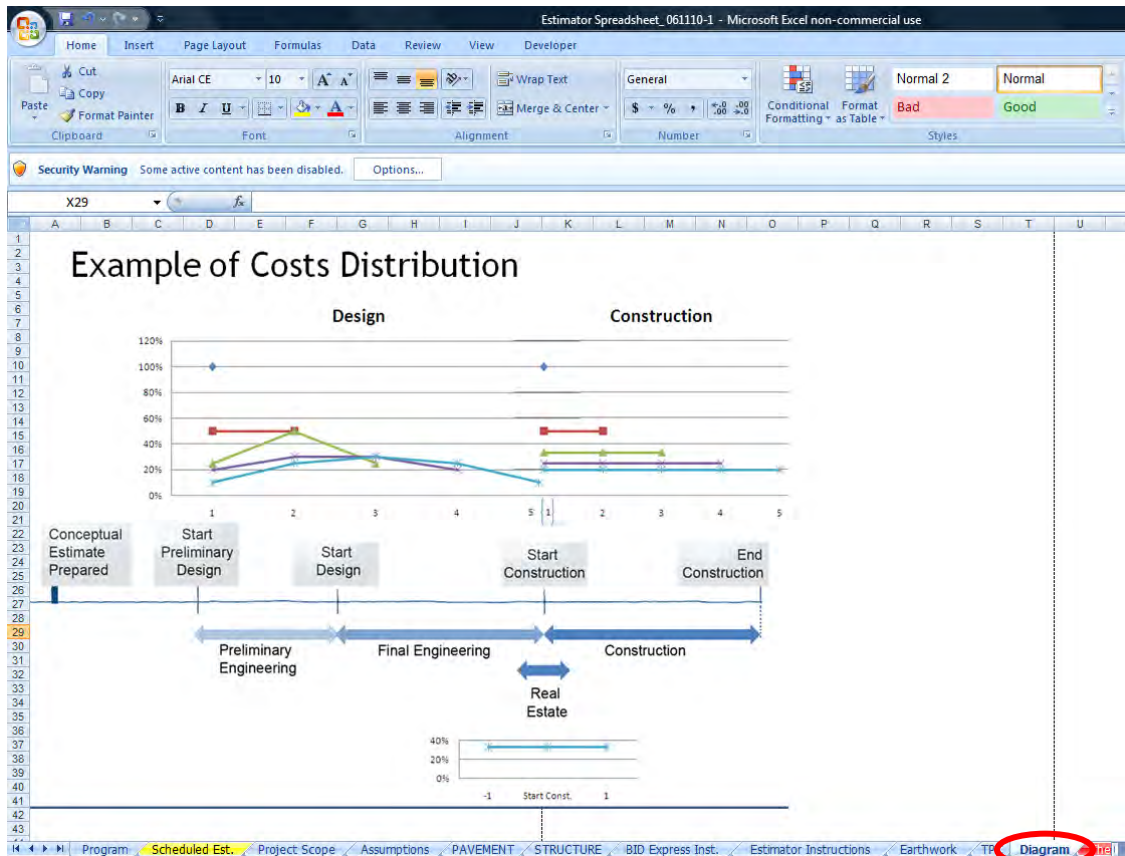
If detailed information is available about when costs will be incurred by the SHA, the user can set up a cost distribution schedule unique to the individual project which can help to increase the accuracy of the conceptual estimate. Users choosing this option should choose the "Scheduled Est." tab.

The user can change the "Scheduled Estimate" matrix to represent the payout schedule of choice.

**Note: When there is a complete estimate, the "Suggested Conceptual Estimate" matrix will populate. This can be used as a reference while filling in your customized scheduled estimate.

Change for customized payout schedule

Scheduled Est. tab

Understanding Output

The Cost Estimating Software was developed to assist in preparing accurate total project cost estimates for WisDOT Majors Projects. As previously stated, it is anticipated that the tool will be used throughout a project's evolution, especially at the conceptual stage, and then again for the final environmental document estimate (20% to 30% design). The program uses historical, as-let data and quantities able to be calculated early in the design phase to accurately estimate additional project costs called Allowance Items. Though much of the data analysis is completed automatically, an accurate estimate still relies on the critical evaluation by the estimator to ensure items are not missed or that items are not counted more than once.

This software program can be used in many ways. It is useful in keeping a running cost estimate during the beginning stages of project design, comparing a few project alternatives, and producing an estimate to be submitted to the Transportation Projects Commission (TPC) for review. However, once this program is submitted to the TPC, the estimate should no longer be changed so that a record of the submitted estimate is available for future reference.

The ultimate output of the estimating software to be submitted to the TPC is a schedule of project costs, available both in current year dollars and in inflated dollars for the year at which the costs will be incurred. There are also several intermediate outputs that are defined below:

Base Construction Cost Estimate: The Base Construction Cost Estimate is the estimate for the total cost to construct the project.

Estimated Contract Let Amount: The estimated costs a contractor would incur on a transportation construction project after contingency factors are applied.

Base Project Cost Estimate: The Base Project Cost Estimate represents the total cost of the project as developed by the design team prior to the project risk analysis being performed. This cost includes allowance items and external costs, but does not include any contingencies for risk nor does it account for inflation.

Conceptual Total Cost Estimate: The Conceptual Total Cost Estimate is the total cost of the project that can reasonably be expected if the project materializes as planned. It is in current year dollars, *before* applying inflation factors, and represents the final project cost estimate that is presented to the TPC for enumeration.

Costs reported in the semi-annual Majors TPC Status Report are also reported in current year dollars. However, if one needs to estimate what the final cost would be if inflation factors were taken into account, then he or she can simply add-up the total yearly values in the last row of the Inflated Dollars table, which sum up to the total inflated dollars estimate.

Throughout the estimating process, there are several opportunities for unique project decisions to be made. The estimating software allows for a lot of flexibility in producing the conceptual estimate including: the opportunity to choose a certainty factor, increase or decrease the estimate depending on the risk analysis, and for the updating of all factors used by the software program.

Using an analysis technique similar to the Program Evaluation and Review Technique (PERT), used in project estimating, allows for statistical inferences to be made using a certainty factor. In this program, the certainty factor was developed to give a percent certainty that the estimate will be greater than the actual cost to complete the project. The variable certainty factor allows the user to balance the need to secure proper funding for projects with the need to expand the program to include more projects.

A key component of the estimate is the Scope Change Increase Allowance. This value is a percentage markup on the Base Construction Costs Estimate (BCCE) to account for additional costs related to potential increases in project scope resulting from more detailed data gathering or design refinements as the project moves through the various design phases. The percentage used for the Scope Change Increase Allowance was determined by surveying each of the Regions about what they believe the markup should be based on previous estimating methods. If a thorough risk analysis is completed, many uncertainties accounted for by the Scope Change Increase Allowance may be eliminated. Therefore, it is suggested that as a part of risk analysis, the Scope Change Increase Allowance should be evaluated. If it

is determined that the percentage is too high, the estimate should be decreased with a negative risk adjustment.

Material costs, inflation factors, project size, type, and conditions all change over time. As changes occur, the software can easily be manipulated to account for the changing times and continue to provide an accurate conceptual project estimate. For direction on updating the estimating software, see the "Estimating Software Update Manual".

Appendix A: Item categories

Barrier Wall	Includes all barrier types and sizes. Unit price includes base and subbase to 2' behind barrier wall.
Curb & Gutter	Includes all curb and gutter types, heights and widths. Unit price includes base and subbase to 2' back of curb.
Earthwork	Includes all types of excavation (common, marsh, rock,...), borrow, EBS, etc.
Pavement, Base & Subbase	Includes all concrete, hma, asphalt, tack coat, aggregate, breaker run, shoulder shaping, geogrid, surface drains, and all other materials associated with pavement, base and subbase on mainline, ramps, cross roads, & frontage roads.
Removing Pavement	Includes all sawing and other activities associated with the removal of concrete pavement and any asphalt overlay.
Drainage	Includes culvert pipe, storm sewer pipe, apron endwalls, catch basins, inlets & cover, manholes and covers, underdrain, etc.
Erosion Control & Restoration	All items associated with erosion control and restoration including erosion mat, erosion bales, ditch checks, silt fence, inlet protection, riprap, topsoil, mulch, seed, fertilizer, sod, plantings, soil stabilizers, cleaning sediment basins, restoration of waterways, etc.
Lighting	Temporary and non-decorative permanent lighting and components including high mast towers and foundations, light poles, concrete bases, luminaries, conduit, electrical wire, control cabinets, controllers, etc.
Roadway Incidentals	All roadway items not included in other categories.
Signing/Marking	Includes all roadway signing and pavement marking including signs, posts, supports, pavement marking paint and epoxy, deliniators, etc. DOES NOT include sign bridges.
Traffic Control & Staging	Temporary and permanent traffic control and staging items including temporary pavement, temporary barriers, temporary marking, temporary traffic control devices including detour signing, permanent signals, cabinets & controllers, crash cushions, includes temporary shoring away from bridges but does not include temporary bridges or temp bridge widening.
ITS/FTMS	All items associated with the integration of advanced communications technology into the transportation infrastructure and freeway traffic management systems.
Structures	All items associated with bridges, retaining walls, noise walls, sign bridges, box culverts and any other structure. Includes excavation and backfill, pavement, pavement markings, all structural components, etc.

Appendix B: Definitions

Allowance Items- Project items that are not sufficiently detailed at the 30% design stage for unit price cost estimating. These items are estimated using a percentage mark up of Major Roadway Items. Currently included as allowance items are: drainage, erosion control, traffic control and staging, lighting, signing and marking, Intelligent Transportation System and Freeway Traffic Management System (ITS/FTMS) and roadway incidentals. (Roadway incidentals is a general grouping of work not included in the other allowance items.)

Base Construction Costs Estimate-*The estimated costs a contractor would incur on a transportation construction project before contingency factors are applied.*

Change Orders & Claims- The total amount reserved for contract modifications, quantity overruns and dispute resolution.

Conceptual Estimate- An estimate that is prepared when there is only a general idea of what the project will entail. At WisDOT, the estimate prepared when only 30% of the design is complete is considered the conceptual estimate.

Confidence-*The degree of assurance in a specific occurrence.*

Construction Engineering Contingency- The total of SHA costs and consultant fees for construction engineering.

Contingency-*Funds reserved to account for the uncertainty of costs.*

Corridor- A collection of construction projects that can be bid and executed individually but are budgeted for as a group.

Estimated Contract Let Amount- *The estimated costs a contractor would incur on a transportation construction project after contingency factors are applied.*

Final Engineering Contingency- The total of SHA costs and consultant fees for final design engineering.

Major Project- As defined in Section 84.013(1)(a), Wis. Stats. There are two categories of major projects:
> Category 1 – a project that has a total cost of more than $30,000,000 and satisfies **any** of the following:

- Constructing a new highway 2.5 miles or more in length.
- Reconstructing or reconditioning an existing highway by either:
    - Relocating 2.5 miles or more of the existing highway, or
    - Adding one or more lanes 5 miles or more in length to the existing highway.
- Improving to freeway standards 10 miles or more of an existing divided highway having 2 or more lanes in either direction.

> Exceptions to the above are:

- A project providing an approach to a bridge over a river that forms a boundary of the state,
- A high-cost state highway bridge project under s. 84.017, or
- A southeast Wisconsin freeway megaproject under s. 84.0145.

Category 2 – a project that has a total cost of more than $75,000,000 and is **not** described in Category 1 above.

Major Roadway Items- Items in a transportation construction project that can be easily estimated in the early stages of project design.

Preliminary Engineering Contingency- The total of SHA costs and consultant fees for preliminary engineering activities.

Program Evaluation and Review Technique (PERT)- The process of assigning statistical certainty factors to project tasks or materials.

Scope Change Allowance- An amount reserved for additional costs related to potential increases in project scope. This results from more detailed data gathering or design refinements as the project moves through the various design phases.

Traffic Mitigation & Public Involvement- An amount reserved for public involvement (newsletters, websites, public meetings, etc.) and traffic accommodations during construction (extra park & ride lots, expanded bus service, expanded police patrols, alternative route locator web tools, etc.)

Appendix C: PERT Formulas

$$Expected\ Value = \frac{[Min + 4(Avg) + Max]}{6}$$

$$Variance = \left[\frac{Max - Min}{6}\right]^2$$

$$Standard\ Deviation = \left[\frac{Max - Min}{6}\right] = \sqrt{Variance}$$