20th Annual National Tribal Transportation Conference

Construction Cost Estimating

Cost Estimating

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September 28, 2017

GOALS

- Understand the project delivery process
- Understanding unit price contracts
- Create a planning level estimate
- Estimating the costs that make up the project delivery process (Consultant contracts)
- Estimating Maintenance costs

What will it cost to do this?

- This is perhaps the most important issue in any project.
- The engineering consultant develops cost estimates to accompany the various design submittals.
- Often, the village will develop planning level estimates.

Resources

- Historic bid results
- RS Means Estimating
- Engineering Consultants
- Other resources

Estimate versus Bid

- Estimate-“an approximate judgment or calculation, as of the value, amount, time, size, or weight of something. “
- Bid-“to offer (a certain sum) as the price one will pay or charge”

Estimate versus Bid

- Both bids and estimates look similar.
- Engineers and owners “estimate”.
- Contractors “bid”. The bid is an **offer** in a **contract** (contract requires both an **offer** and an **acceptance**)

- Engineers typically use historic bid prices to estimate unit costs….bid prices from other similar projects that have occurred in recent time.
- Contractors determine actual costs.
  - Quotes from suppliers
  - Quotes for logistics
  - Earth materials costs based on their unique means and methods
  - Actual labor costs
  - Proprietary considerations….profit margin, interest rate….

- Engineers (representing the owners) ask
  - -”Do we have enough money to build this?”
  - -”How much money do we need to budget?”

- Contractors ask:
  - “Can I make a profit?”

Estimating is both an art and a technical expertise

- Requires knowledge of construction means and methods
- Knowledge of arctic logistics
- Knowledge of materials, products, and equipment
- Knowledge of economics
- Knowledge of labor and environmental law
- But, there are many nuances and intangible aspects, that cannot be directly calculated

Different types of estimates based on accuracy and level of completeness

- Several estimates produced during design process
- The estimate evolves, because engineering is an iterative process.
- Estimates get more accurate as design progresses
- Planning level estimate
- Estimates to accompany intermediate design submittals
- Final estimate
- Contractor bid *(still kind of an estimate-why?)*
- Final project cost at completion (why?)

Different types of project delivery

- Design bid build
- Design build
- CMGC

- These are typically structured as “unit price” contracts.
- “Unit” really means “unit of measurement”
- “Units” are accompanied by “Pay Items”
- *Go over bid tabulation sheet*

Compilation of Bids

- Is an itemized breakdown of the project cost
- Pay items and unit costs
- Contains the engineer’s estimate
- Contains contractors bids
- Low bid
- Compare engineer’s estimate to low bid
- Compare all estimates/ bids to each other

Types of Units

- Lump Sum
- Linear Foot
- Each
- Cubic Yard
- Ton
- Square Yard
- Contingent Sum
- Station
- Pound
- Labor Hour

What are appropriate unit costs?

- Use bid results from similar projects.

How much is a Cubic Yard?

“End Dump” Truck=

- 10 Cubic Yards
- 20 tons
- What is the value of the material in the back of this truck?

Unit Price Contract
versus
Lump Sum Contract

- Why are transportation projects delivered as “unit price”?
- Most work quantities are difficult to define
- Unit prices allow us to pay the contractor for the work that they do….not more, not less
- Lump sum contracts don’t have the flexibility of a unit price arrangement.
- Example: “differing site conditions”, quantity errors

“Differing Site Conditions”

- ADOT, Standard Specifications, 104-1.03
- Example: saturated soils
- Example: permafrost or massive ice
- Example: bedrock

Quantity errors

- Very common
- Difficult to “calculate” quantities….and thus, we “estimate”
- Engineers use “models” and “approximations” to estimate quantities
- Software produces “surface models”
- Average end area
- Error example: failed to compensate settlement of “duff”…vegetative mat
- Error example: settlement of subgrade

If the actual quantities differ substantially from the estimated quantities, the contractor may re-negotiate the unit cost.

- Standard Specifications section “109-1.04 Compensation for Altered Quantities”

Unit price contracts help to compensate for uncertainty in material quantity calculations.

Estimate Construction costs with a Planning Level Estimate

- Estimate-a prediction of what something will cost
- Planning Level-An initial estimate. This is a "ballpark idea" of what the project will cost.

Planning Level Estimate

- As the design of a project is developed various estimates are made. Each estimate gets more accurate than the previous one.
- The Planning Level Estimate is the first estimate made.
- It helps us know, ahead of time, how much funding($$) we will need to construct the project.

Planning Level Estimate based on length of project

(project length in miles) X

($/mile factor)

=project cost

How do you determine the length of a project?

- Google Earth
- Measure it off of a topo map
- Walk the project alignment and “pace it”
- Use a pocket chronometer
- Measure it with a rag tape
- Use a “chainman”
- Directly off of your **Long Range Transportation Plan (LRTP),** inventory, strip map

How do you determine the length of a project?

- Roads are usually not straight.
- They “meander” to avoid wetlands and geologic hazards.
- Is there an established 4 wheeler trail where you want to build the road? Then use the trail length as your road length.

$/mile

- What does it cost, to construct a 2 lane gravel road, in rural Alaska?

- How many dollars does it cost to construct a 1 mile long gravel road?

Look at recent construction projects

- Galena Campion Rd.- 2.5 million $/mile
- Stevens Village Sanitation Rd- .5 million $/mile
- Huslia Landfill Rd.- 1.2 million $/mile
- Gambell Evac. Rd.- 1.8 million $/mile
- Emonack Roads- 3.1 million $/mile
- St. Mary's/ Mountain Village Road-.7 million $/mile (rehabilitation)

- This averages to 1.6 million $/mile

Why do the $’s /mile vary so much on these projects?

-All projects are unique.

-Forest service roads have lots of curves. Why?

All projects are unique

- Logistics-Where is the community located?
- Competition, how many bidders were there?
- Are there Borrow materials available? Or not.
- Earthmoving quantities-this is huge…..earthmoving costs dominate the total construction cost.

$/mile

- I usually start with 1.5 million dollars/ mile to construct a new, 2 lane, gravel surfaced road.
- You may want to adjust this number after the “scoping” process.
- What figure you use for $/mile, is a matter of judgment.
- Ask the engineering consultant that you are working with for guidance.

Next step-estimate **Construction Engineering** costs

- **Construction Engineering**-management, inspection, materials testing, etc.
- Estimate **Construction Engineering** as a percentage of your **Construction** estimate.

Estimate **Construction Engineering** Costs

- Department of Transportation projects typically range between 10%-15% of construction estimate.
- BIA Delivery Guide also says 10%-15%

Next, estimate **Preliminary Engineering** costs

- **Preliminary Engineering-** environmental (NEPA) process, surveying, material drilling, ROW, Utilities, sealed Plans/ Specifications/ Estimate (PS&E), etc.
- Estimate **Preliminary Engineering** as a percentage of your **Construction** estimate.

Estimate **Preliminary Engineering** Costs

- Department of Transportation projects typically range between 4%-10% of **Construction** estimate.
- Other sources (internet, professional publications) say 7%-10% of **Construction** estimate.
- BIA Delivery Guide says 10%-25%

Estimate **Preliminary Engineering** Costs

- Galena Campion Road (3.8 miles)-**Preliminary Engineering** costs were 13% of **Construction Costs**
- Stevens Village Sanitation Rd.(2.4 miles)- 42%
- Dalton Highway Project (26 Miles)-5.2%
- *Jeff find more examples*

Estimate **Preliminary Engineering** Costs

- How should we estimate Preliminary Engineering Costs? What percentage of the construction cost?
- 5.2%? 13%? 42%?.....
- This is confusing, this data is not consistent.
- I think the BIA guidance of 10%-25% is accurate.
- Lets use 20% as a rule of thumb for initial estimate.

Sample Statement of Work

- Estimating construction costs is an art, that requires experience.
- You have the option of hiring an engineer to perform the estimate for you.

Exercise

- Determine planning level estimate
- Use the Galena figure
- Construction cost (length x $/mile)
- Construction engineering (15% x construction cost)
- Design (20% x construction cost)

SV versus Galena (see handout)

Project Name	design cost	contractor bid	design cost, % of construction cost	length, miles	construction cost $/mile	borrow quantity, Tons	tons of borrow/ mile
Galena Campion Road Erosion Protection	$1,289,733	$9,879,853	13.1%	3.9	$2,559,547	247,826	64,204
Stevens Village Sanitation Road	$798,061	$1,250,600	63.8%	2.4	$521,083	36,500	15,208

Estimating Borrow Quantities

- Average end area
- Software-AutoCAD Civil 3D

Estimate Borrow Costs

- Use historic bid prices

640(1) Mobilization and Demobilization

- Can be a substantial cost in rural projects
- This pay item is frequency balanced
- Consider the cost of staging. Example:Galena Campion Road.
- Will often be 20% of the bid on rural projects.

Estimate from plan “estimate of quantities”

- Use historic bid prices
- Only low bid matters
- Discuss “bid balancing”
- Effect of “economy of scale” on unit prices
- Inflation….what year is the historic bid price from?
- Price escalation

Estimating Maintenance Costs

- I recommend 2 staged approach.
- 1.Make educated guess regarding equipment and labor hours that will be used, materials that will be used, and apply standard equipment and labor rates with standard material price quotes.
- 2. Keep records of your actual maintenance costs, and use these to estimate future costs.

Estimating Maintenance Costs Educated Guess

- What equipment does your Village own? Make a list.
- Assign hourly rates to the equipment. Use equipment rental rates from nearest City.
- Make a list of hourly wages of Village maintenance employees.
- Determine material costs, most importantly, borrow costs.

Estimating Maintenance Costs Educated Guess

- Go over “worksheet for estimating TTIP maintenance costs”
- You want to break your estimate into 3 components:
- 1.Equipment (by type, hours, and hourly rate)
- 2. Labor (by hours and hourly rate)
- 3. Materials (by type, quantity, and unit cost)
- Finally, add contingency and overhead

Estimating Maintenance Costs Educated Guess

- Go over my example worksheet

Estimating Maintenance Costs from Past Maintenance Costs

- 1. Over the course of a year, keep records of your maintenance costs.
- 2. When putting together your TTIP for the next year, make the assumption that the costs will be the same as the previous year.
- 3. Over the next year, keep records of your maintenance costs.
- 4. Through this process, you gain a very accurate record of what maintenance will cost.
- 5. Your annual costs will (probably) be consistent.

Maintenance Record Keeping 101

- Go over the “Worksheet for Maintenance Record Keeping”
- Track 3 things: Equipment, Labor, Materials
- There should be one person responsible for keeping the records.
- On any day that maintenance is performed, fill out the worksheet accordingly.
- Keep the worksheet(s) in a designated location.

Maintenance Record Keeping 101, Continued

- Also keep any receipts for material purchase, payroll records, parts, fuel. Etc. in the same designated location.
- On an annual basis, add all of the costs to a single lump sum.
- I recommend the use of an electronic spreadsheet, but paper records are acceptable.

Maintenance Exercise

- Estimate the cost to apply calcium chloride to the full length of SV Sanitation Road.
- 1 pound/ square yard application rate.

What does it cost to construct a boardwalk?

- Elfin Cove Boardwalk-.95 million $/mile
- Elfin Cove Boardwalk-179 $/foot

- Selawik Boardwalk (2007)- 1.7 million $/mile
- Selawik Boardwalk (2007)- 321 $/foot