AC 2009-863: INTRODUCTION TO ESTIMATING AND BIDDING USING A FLAGPOLE

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Introduction to Estimating and Bidding Using a Flagpole

Introduction

In order to introduce the concepts of estimating an exercise was developed to assist students with little or no construction experience. The in class exercise is to estimate the cost to install a 25 foot aluminum flagpole and foundation. Material, labor and equipment costs are provided to the students in addition to specifications, drawings and a bid form. This paper will explain the exercise and examine the results from over 500 students that have participated in the exercise. The student result will be compared to published prices for installation of similar flagpoles. A follow-up exercise uses the flagpole as an introduction to shop drawings where students review and submit a shop drawing of a flagpole.

Course Background

The three credit course, Fundamentals of Construction Engineering, is required for all Civil Engineering students in Civil and Environmental Engineering at Michigan Technological University. The class is available to sophomores and has a typical enrollment of 60. The author has described this as a "smorgasbord" course since numerous construction topics are included. This "smorgasbord" of topics includes a construction industry overview, common construction terminology, contracts, project delivery systems, cash flow, equipment ownership, equipment productivity, estimating, planning, scheduling, quality and safety. With this broad range of topics it is difficult to cover things in depth. Therefore, it is important to illustrate topics in a meaningful manner.

The author has taught the course 19 times and has tried to develop techniques that are not only interesting to the student but keeps the instructor interested and excited about the material. The exercise presented in this paper, an introduction to estimating and bidding is one of those.

What is estimating and bidding?

Those who have taught estimating or who have worked in the construction industry are able to describe what estimating is. However, for 19 or 20 year old college students with limited experience it may be difficult.

When I was a student, my college dictionary would be the first place that I would look for an answer. Random House's definition is "to make an approximate calculation of (value, amount, size, etc.[1])" Today's student would look online. The online Merriam-Webster dictionary provides this definition as a noun: "the act of appraising or valuing" and as a verb: "to judge tentatively or approximately the value, worth, or significance of.[2]" Another place on the web that students would look would be Wikipedia where the definition of "Estimation is the calculated approximation of a result which is usable even if input data may be incomplete or uncertain.[3]" If a student followed the link to estimation related to project management they would find the following definition: "In project management (i.e., for engineering), accurate

estimates are the basis of sound project planning.[4]" From this brief review of definitions the basis for estimating can be described by some of those words: approximate, value, incomplete data, accurate, and project planning.

The course text describes estimating as "… the process of looking into the future and trying to predict project costs and resource requirements.[5]" Knutson et. al. state that "Estimating is determining how to construct the specified work in the most economical manner and within the time allowed by the contract.[6]" An Associated General Contractors publication on estimating says "… a contractor must be able to visualize the construction process for a project, to understand the way that the work is to be performed and the time required based upon a set of drawings and specifications.[7]" These descriptions of estimating point out the need for resources, time, understanding and visualizing the process, and understanding the contract documents.

If we follow a similar method to define bidding as we did for estimating it starts with a dictionary where bid is defined as "to make an offer of a price to secure a contract.[1]" Merriam-Webster's noun definition is: "a statement of what one will give or take for something; *especially*: an offer of a price.[8]" Wikipedia's definition is: "Bidding is an offer (often competitive) of setting a price one is willing to pay for something. [9]"

Understanding of and an ability to correctly complete the bid form is crucial as "Failure to execute properly insert all the required items on the bid form may be the cause for the bid to be needlessly declared nonresponsive.[7]"

The challenge is to deliver all of this to a group of students of which some have neither construction experience nor do they understand the technology of construction. The exercise presented in this paper is an attempt to introduce students to estimating using a relatively simple item that may contain elements that they are already familiar with. The intent of the exercise is to get students to identify the activities using the drawing and specifications, determine how long the activities will take, change this time to cost using labor and equipment rates, and correctly complete the bid form.

Description of Exercise

This exercise is presented at the start of the section in the class on construction estimating. There has been no discussion on the topic although students may have read the text. The class has already covered the process of how contractors get work. Topics related to equipment productivity have also been covered. Additionally, calculations for the cost of equipment and labor have been explained.

The exercise is to estimate the cost to install a flagpole and foundation. Each student is provided the sheet shown in Figure 1. Included are the cost of labor, any equipment, material (concrete and flagpole), overhead and profit. A drawing of the flagpole is provided. The sheet also serves as the bid form and requires the student to provide a price (in words and figures), labor hours and a breakdown of costs. The bid form has places for a signature and a date. A place to indicate what type of equipment is also provided. In addition to the information shown in Figure 1

students are provided with a blank page for any calculations plus the specifications for the flagpole from a project manual.

Due Date: **Today in CLASS**

Work Individually

Estimate the cost to install (complete) the flagpole shown in the drawing and described in the attached specifications. The cost of labor is $30/hour (all markups included except OH and Profit). Use $50/hour (operator included) for any equipment. Equipment must be charged out in increments of 4 hours. The cost of delivered concrete is $75/cy. The cost of the flagpole and any accessories is $725.00. Include all material necessary for installation in accordance with the drawing and the specification. Complete the following summary of material, labor, & equipment. A sheet is provided for your calculations. Use 10% overhead and 5% profit.

DO NOT USE R.S. MEANS, Richardsons or any other source!

The price (all labor, material, & equipment) to install the Flagpole is:

_____ ( ).
{In Words} {In Figures}

Labor hours: _____
(Include Operator if Applicable)

Breakdown of Costs:

Material _____

Sales Tax _____

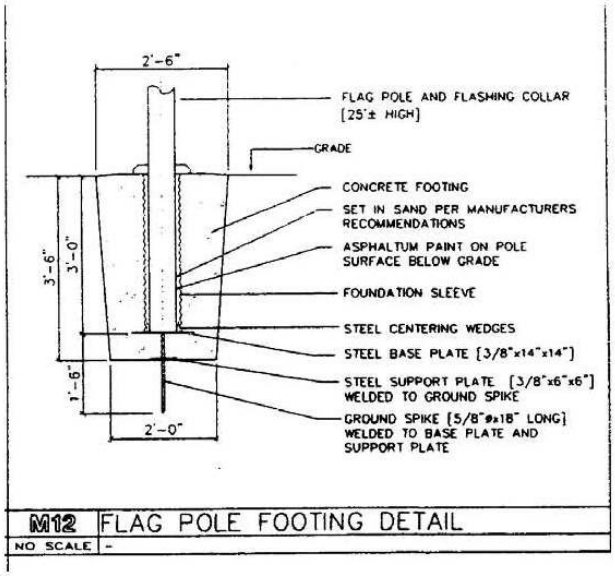
Labor _____

Equipment _____

Overhead _____

Profit _____

Total Price _____



What equipment, if any, did you use?

Submitted By: _____

Date: _____

Figure 1 Flagpole Estimating

After the students review the material there may be a few questions asking for some type of labor productivity to assist them in determining the labor hours. The response is to "estimate" how long it will take. The flagpole is ideal for an introductory exercise since there are only a few

activities: excavate (or dig) a hole, set foundation sleeve, place concrete, and set pole. This permits the majority of students to identify these activities. While it is rare that any student has actually installed a flagpole the activities are such that they may be familiar to them. Most of students have dug a hole as well as mixed concrete. Some have set some type of pole or fence post. Those students can use their experience in determining a time estimate. For those that do not have any experience the activities are simple enough that it is possible for them to estimate reasonable durations.

The amount of time for students to do this exercise is 25 to 30 minutes. The author usually does it at the end of the class period and students may leave when they have completed it. Before the next class session the exercise is graded. A point is deducted for each blank not filled in and these bids are considered non responsive. The process that students used is reviewed and comments and notes made as necessary. During the next class session a "bid opening" is held where the following is reported: lowest price, highest price, least labor hours, most labor hours, averages, engineer's estimate, unusual construction techniques or interpretations of the contract documents. Additionally, historical values from previous class and published values of flagpole installation costs are reported.

Following class sessions discuss the need, types, and process of estimating. Included in this is a discussion and assignment using R.S. Means.

Flagpole Results

The results that are reported in class are shown in Table 1. The engineer's estimate is the author's based upon experience as an estimator. It should be noted that the author has never installed a flagpole or watched the installation of one. The engineer's estimate includes the cost of the flagpole at $725.00 plus 1 cubic yard of concrete at $75.00. The total materials are $800.00 plus 6% sales for a total of $848.00. Labor was estimated at 6 hours for a crew of 2 for a total of 12 labor hours. This results in $360.00 of labor. Note that the labor hours of the operator are added to the labor hours of the crew for a total of 16 which is reported in Table 1. Four hours of equipment (backhoe/loader) are used for an equipment cost of $200.00. Last, the 10% OH and 5% Profit are added for a total of $1626.24.

The average estimated price to install the flagpole and foundation of the students that have done the exercise is $1,825.11. This is higher than the Engineer's Estimate and is a result of some very high prices such as that shown in Table 1 for the highest cost. That particular student "busted" on a decimal point and the price that they had calculated was $6, 288.85. However, they had $62,885.50 listed on the bid form. The lowest cost was a failure of the student to include the cost of the flagpole ($725.00). Both of these errors are made by contractors and the implication of such errors is discussed during the "bid opening". The prices that the students develop are also compared to published data such as RS Means[10] and Walkers[11]. This comparison shows that the student prices are reasonable.

The estimated average labor hours for the students (9.0) are lower than the Engineer's Estimate (16.0) and also the published values that were available (12.6). This is primarily due to the majority of students not using any equipment to install the flagpole as the labor hours for the equipment operator are included in total labor hours. Estimating of labor hours proves to be one

of the hardest tasks for students to learn. This exercise provides them an opportunity to develop those skills. Additional discussion on the consequence of low or excessive labor hours is done during the bid opening.

The results show that students can estimate a simple task such as the flagpole. The hope is that the basic estimating process can be expanded to more complex items by breaking them into smaller, more manageable tasks. Students that take the senior estimating elective have that opportunity.

Table 1 Flagpole Results

	Cost in Dollars	Labor Hours
Engineer's Estimate	1,626.24	16.0
Average of 593 students	1,825.11	9.0
Lowest Cost	160.45	2.0
Highest Cost	62,888.58	5.0
Least Labor Hours	944.67	0.5
Most Labor Hours	5,755.00	128
RS Means[10] Flagpole, Ground Set, No foundation, 25' high	1,350.00	9.412
RS Means[10] Foundation for flagpole, including excavation and concrete, to 35' high	625.00	3.2
Total for RS Means	1975.00	12.612
Walker's[11] 40', ground type, cone tapered steel, including fittings, ground tube and flashing collar, no foundation.	1700.00	NA

Use of the Flagpole for Shop Drawing Review

Once the topic of estimating is completed the subsequent topic in the class is shop drawings. The need for shop drawings and the review process is discussed. Students are then provided with a shop drawing for a flagpole such as that provided by Elder Flag[12]. The intent is that they have been awarded the project and the shop drawing has been provided to them by a vender. The flagpole shop drawing given to the students nearly meets the specification/drawing that was provided to them when they were bidding. Additionally, the General Conditions from a contract are provided to them that explains the submittal process. Students are required to follow the submittal process in their review of the shop drawing. It is suggested to them that they list everything that is required by the drawings and specification and compare with that shown on the shop drawing. The benefit of using the flagpole in the shop drawing review is that the students are somewhat familiar with the flagpole from the estimating exercise.

Summary

This paper presented an in class exercise used to introduce students to the process of estimating which included contract document review, quantity takeoff, method analysis, pricing, and bid submittal, While a simple task for experienced estimators many students have no experience in estimating. Additionally, they only feel comfortable estimating items that they are familiar with

or have actually done. This exercise provides an easy to implement estimating exercise that illustrates the important aspects of estimating. The results of 593 students estimating the flagpole show that for simple task students with little or no experience can estimate a reasonable cost. This builds confidence as they estimate more complex tasks. The same flagpole is used to illustrate the contractor's responsibility in shop drawing review.

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