**CVEN 4087/4434**

**Construction Engineering Project Plan Assignment**

**Spring 2008**

## Context

The preconstruction phase is arguably one of the most important phases of construction on any project. Pre-planning before construction begins is critical to a successful project. Pre-construction analysis can include such activities as schedule development, risk and opportunity analysis, safety plans, equipment resource plan, site planning, project organization development, human resource staffing plan, subcontract development, material buy-outs, documentation/communication plan, value engineering, etc. It is fair to say planning how to administer a complex project such as the Boulder Wastewater Plant retrofit is a large undertaking. Given the scope of this project and the time constraints for this course your assignment will be limited to Aeration basins 1 – 3 (AB 1, AB 2 & AB 3) and Secondary Clarifier 4 (SC 4) except for the third phase discussed below. For the first phase of the assignment you will develop a precedence diagram (CPM schedule) and means & methods narrative for this reduced scope.

The second phase of this assignment will involve the development of a quantity survey for SC 4; structural concrete only. Hard pricing by the general contractor (GC) is not possible without an accurate quantity survey. The quantity survey often plays a dual role as a key resource for developing the construction schedule (Therefore you may wish to complete the quantity survey before developing your schedule!). Quantity takeoff is more than just determining the quantity of permanent materials that will be incorporated in the project; it includes identifying quantities relating to all detailed activities of work such square foot of forms required for structural walls, SF of fine grading for slabs on grade, C.Y. of structural excavations, etc. The hard bid estimating process, including the quantity survey, is essentially an exercise where the project is built on paper.

The third phase of your assignment entails value engineering. This is the only phase where the scope may extend beyond AB 1-3 and SC 4. Value engineering is essential both during the design and construction phase of any project. Good value engineering addresses both constructability and alternatives designs that will not reduce quality, design life and or in way compromise the vision of the client.

Selecting competent subcontractors is another key aspect of the pre-construction phase. Selection solely based on price may not always result in the best outcome. For major items of work it is not uncommon to pre-qualify potential subcontractors to reduce risk of making a bad selection. After a subcontractor is selected the next critical step is to develop a well designed subcontract. For this last phase of your assignment you will develop a prequalification application and a subcontract for a key item of work defined below.

## Resources Available

- ✓ **Primavera Software (P3) Bechtel Lab**
- ✓ **Plans**
- ✓ **Sample quantity survey form**

- ✓ **Sample subcontract**
- ✓ **Sample RFI's**

**Assignment**

*Schedule (15% 0f Grade)*

- Develop complete list of construction activities for AB 1-3 and SC 4. Note: You may find it useful to categorize your activities logically by work type's i.e. structural concrete, pipe, structural steel, etc.
- Develop a detailed precedence diagram
- Complete a forward and backward pass calculation
- Considerations
    1. *Timing for construction of AB 1-3 and SC – 4 i.e. Concurrent construction?*
    2. *Calendar day time count – how to maximize use of time? How many days should be allowed for this work? – List your assumption for time count.*
    3. *Site planning/space considerations*
- Deliverable shall include a construction activity list and schedule (precedence diagram).
- The CEM representatives in each group should be capable of utilizing P3 software. If any groups need assistance I will ask one of our graduate students to provide support as needed.

*Means and Methods Narrative (15% of grade)*

- The narrative should address three primary components:
    1. *Construction overview – This is a discussion of how you plan to construct the project. It is intended to supplement the understanding of the detailed construction schedule. This is a high level overview to help the first time reader understand your approach. Owners and designers often find this discussion useful in understanding the sequence of work. Limit your discussion to major categories of work as the schedule contains the details.*
    2. *Risk and Opportunities – During your review of the plans, specifications and site what concerns you regarding construction? How might you mitigate these perceived risks? What opportunities might there be to save costs, accelerate the schedule, etc?*
    3. *Safety – Delivering a safe project should be foremost in the minds of all key project stakeholders. Developing a detailed project specific safety plan can be an extremely involved process. For this assignment identify 3 to 5 major safety risks and discuss how you will work to mitigate these risks during construction. Discuss actions that will need to be taken.*
- Deliverable should be a maximum of 8 double spaced typed pages (size 12 fonts) excluding cover page. The deliverable shall be professional in all respects. Assume your audience is the Owner who is not an expert in understanding detailed schedules. The narrative will go a long way in assisting the Owner in understanding your construction approach. Approximately half the deliverable should be committed to the construction overview discussion. Your cover page should address this document to the Project Owner.

*Quantity Survey (20% of Grade)*

Complete a detailed quantity survey for all structural concrete in SC 4. Quantity takeoffs shall be reflective of the actual construction activities that will need to take place during construction. For structural concrete at a minimum the following activities should be considered:

- ✓ Fine grading below slabs
- ✓ Formwork for concrete slabs
- ✓ Formwork for concrete footings
- ✓ Formwork for concrete walls
- ✓ Other formwork
- ✓ Concrete pours - just concrete material takeoffs
- ✓ Reinforcing steel takeoff
- ✓ Wall Block-outs
- ✓ Anchors bolts

Your deliverable shall be an Excel spreadsheet that that shows your quantity take-off for each activity you identify listing quantities and proper units of work. It is likely your spreadsheet will not be more than one or two pages. An example quantity takeoff will be worked through in class.

*Value Engineering (20% or grade)*

For this phase your assignment is to consider two aspects of the design work you completed earlier in the semester that you felt could be difficult and/or expensive to construct. There will be no written deliverable for this phase of the assignment. Instead each team will make a presentation to the project owner in class making an oral argument for altering the design. You have the option to use a Power Point presentation and/or handouts to make your argument. This presentation will be combined with your final course presentation. Your grade will be based solely on your presentation. The course professor(s) will act as the Owner(s).

*Prequalification (15% of grade)*

Assume you are acting as the project manager for the general contractor and your company is considering subcontracting the structural concrete work for AB 1-3 and SC 4. Normally your company would self perform this work, but given the current heavy backlog your company is enjoying the general manager wants you to consider subcontracting this work if you can obtain competitive pricing. When the project was bid no subcontract quotes were pursued for this category of work. The project was estimated to self perform this work with in house crews. Given the company concrete crews may not be available when you will need them it is essential you try to find a qualified subcontractor that can complete this work at a price within the constraints of estimate. Given structural concrete is the major component of work on these structures it is imperative you properly prequalify interested bidders. Your prequalification statement should address at a minimum the following:

- ✓ The proposal will be lump sum fixed price.
- ✓ Scope of work (think beyond just the plan pages and decide what you may want to include and/or exclude from the scope, such as certain materials, other?)
- ✓ Track record submittals (Note: this can be a broad item)
- ✓ Safety record

- ✓ Types of security
- ✓ Other??????

Include everything you think is important and reasonable you would want to understand in addition to price to make an informed selection. Limit your prequalification statement to a maximum of 4 double spaced typed pages. I will be looking at your depth of thought surrounding what areas of risk you want to control with this information request, how concisely you state your requests and the overall professionalism of your submittal.

*Subcontract (15% or Grade)*

Assume you have selected Boulder Structural Concrete Contractors (BSCC) as your subcontractor. One of the most important aspects of any subcontract is the development of additional provisions, which you can label as an exhibit (refer to section 5 of the sample subcontract provided) and would be made part of the subcontract. This exhibit should define any special provisions you wish to address including exclusions and inclusions that require additional definition beyond the normal "boiler plate" language in most subcontracts. You will be furnished a copy of AGC subcontract form #621, the subcontract agreement your company utilizes for reference. You may want to consider combining what could be multiple exhibits into one or two exhibits. Assume the subcontractor included in their written proposal to you the following special conditions:

1. Concrete will be furnished by others.
2. Reinforcing steel placement included, but materials furnished by others.
3. GC will be responsible to provide reasonable access for a concrete pump and hydraulic crane adjacent to the work.
4. GC shall provide all embedded materials for placement by BSCC.
5. Add 1.5% to proposal price in performance and payment bonds required.
6. Surveying excluded, furnished by others
7. BSCC not responsible to protect existing buried structures and/or improvements
8. Proposal is based on 40 hour work week Monday through Friday. Any overtime will be billed as an additional cost to GC.
9. BSCC will submit progress payments at the end of each month and will be paid by the 15$^{th}$ of the following the month less contract retainage.
10. Retainage will be paid in full within 60 days of completing all structural concrete work.

Keep your exhibit submittal to a maximum of two typed pages.

**Due Dates**

- Value engineering presentations will be combined with your final course presentation.
- Your other deliverables will grouped together as follows:
    1. Schedule and means and methods
    2. Quantity survey
    3. Prequalification and subcontract exhibit(s)

  You can determine what order you submit these deliverables as long as I receive one deliverable on each of the following dates: 4/10, 4/17 and 4/24.

**Questions**

Questions should be addressed to the course professor in the form of RFI's (Request for Information). Students will be provided a sample RFI to work from in developing their own RFI. Student teams my submit RFI's via email to course professor or provide a hard copy during class time. Professor shall have the option to reply in writing or verbally during class time. In either case the professor shall have a maximum of four calendar days to provide a reply or you can submit a delay claim!