Design/Build Projects for a Public Agency: Lessons Learned

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ABSTRACT

Design/Build project delivery mechanisms have become increasingly popular because they offer advantages in speed of completion, efficiency, and in many cases, cost savings over conventional design/bid/build project delivery. However, there are cases where the promise of design/build has not been delivered, and accompanying painful lessons learned. There are particular difficulties in executing a design/build project for a public agency because there are strict constraints on procurement, budgeting and project tracking.

This paper will explore the lessons learned during the execution of a design/build delivery of a wetlands mitigation project for the Port of Houston Authority. The project is a medium-sized undertaking (less than $2 million total cost) with an aggressive initial schedule and considerable dependence on weather conditions. The paper will outline the preparation steps that led to the decision to execute the work on a design/build basis; the selection process and contracting; the advantages that resulted from using this delivery mechanism; and a list of suggestions for future projects where this method of delivery is required.

INTRODUCTION

The Port of Houston Authority (PHA) operates several major facilities along the Houston Ship Channel and Galveston Bay to meet its primary mission of providing a secure port of entry for goods into the Texas Gulf Coast. In order to continue its successful growth in this role and to meet the increased demand, the PHA has planned the construction of a new terminal facility in Bayport, to provide both cargo receipt and cruise ship space.

A part of the new terminal design process required the mitigation of approximately 20 acres of freshwater wetlands that would be impacted by the construction of the new terminal facility. The United States Army Corps of Engineers (USACE) has jurisdiction over the issuance of wetlands permits, and as part of the permit approval process, the PHA was required to mitigate wetlands at a 3:1 ratio, and to commence construction of the wetlands concurrent with the construction of the terminal itself. This schedule constraint required that the project be executed in a design/build basis.

The permit negotiations with both the USACE and several other regulatory agencies led to an unusual conceptual design that created two large, very flat basins to take advantage of the natural topography and minimize the amount of intrusive construction required.
CONCEPTUAL DESIGN AND PERMITTING

The conceptual design and the approved wetlands mitigation permit were developed simultaneously as a result of the discussions with the relevant agencies. Since a quasi-prairie approach was strongly urged by the Texas Parks and Wildlife (TPW) department, the hydrologic modeling had to deal with widely varying rainfall amounts in a very shallow basin that did not encourage the presence of open water. This condition is routinely observed in small “pothole” wetlands that depend on regular precipitation for wetlands species survival, and may not have these species present during dry periods. However, the construction of large (>20 acre) basins using this conceptual design is novel. The modeling indicated that each basin would have some water present most of the time during normal precipitation years, but would dry up during drought periods. This variability would be expected to produce significant vegetative competition as conditions changed from wet to dry soil.

The conceptual design called for the creation of earthen levees to impound rainwater in the appropriate areas; spillways to channel excess precipitation into the Taylor Bayou lateral adjacent to the intended area; and planting of selected freshwater species in the resulting basins. The area was surveyed and a conceptual design was developed that created approximately 68 acres of new wetlands pool area, and preserved approximately 4 acres of existing wetlands within the pool areas. The area was divided into two basins of approximately equal size to provide the necessary shallow areas based on the survey, with a spillway between the south and north basins to maintain the south basin water level below a set elevation. The north basin spillway drained to the Taylor Bayou lateral (lateral) to serve the same function.

A condition of the permit also required active control of specified noxious species, including cattails and Chinese Tallow. Upon receipt of the permit approval from the USACE, PHA promptly began tallow control by contracting for the cutting of tallow trees starting from the south side of the property. Cattail control was not required since the wetlands area had not been constructed yet.

The project was the subject of a Request for Qualifications from the PHA, and a design/build team of four companies was selected and contracted to perform the work. A design/build approach was used in order to minimize the time required to proceed from a detailed design to construction, in order to meet the wetlands permit schedule. Construction and planting were expected to be completed within a single season, and the approved budget relied on this assumption.

DETAILED DESIGN

Detailed design work commenced immediately upon contract execution. The design was completed in approximately 3 months from project initiation, and was reviewed and approved by the PHA Engineering Department. A set of plans was submitted to the Harris County Public Improvement District (HCPID), and they responded by indicating that a separate stormwater management plan and permit would be required by the City.
A condition of that permit was that no construction could commence until the permit had been issued. A plan and permit application was rapidly assembled and approved on an expedited basis.

While the design and permitting process was being completed, pre-construction activities by the construction contractor included significant tallow removal using track hoes and chainsaws. The trees, many 15 feet or more in height, were cut near the base and staged for shredding. The stumps were pulled using the track hoes and also staged for shredding. The trees that had been cut during earlier tallow control activities were also removed for shredding. Since the property contained a significant stand of tallow trees, this process required several weeks to complete.

In addition to tallow removal, the area that was to be used as a borrow pit in the north side of the lateral was prepared by removing tallow and other vegetation and placing stormwater controls (silt fence) around the area.

CONSTRUCTION

In preparation for the commencement of construction, the team surveyor placed cut and fill stakes along the intended levee locations. When the survey team reached the northeastern portion of the site, they noticed that their observed elevations did not match the survey used for the design. Rapid troubleshooting indicated that the initial survey contained errors in this portion of the site, and the design process would have to be repeated. The redesign was performed on a very expedited basis (in two weeks), and the redesign used as much of the conceptual design as possible to ensure that the areas and general appearance would match the original permit. This meant that soil would not be transported across the lateral, but the levees would be wider than originally planned to use the soil generated from the now required cut operations over 20 acres of the construction area. The redesign was submitted and approved on an expedited basis, and the stakes were adjusted accordingly. The construction process proceeded smoothly once the redesign was reviewed, and the levees were placed, compacted and seeded within six weeks. The spillways were constructed at lower elevations than the surrounding levees, and large concrete riprap areas were placed downstream of the spillways to manage sediment movement.

Each basin was designed to contain approximately 35 acres of pool area at a depth ranging between 1 and 12 inches. Much of the area was expected to have a water depth of 4-6 inches at full pool. At full coverage by vegetation, the open water area was designed to be less than one acre total.

PLANTING

The planting requirements were specified in the permit. A detailed planting pattern was developed by the ecological team member to provide optimum chances for successful plant survival based on expected water depth. However, at the completion of the construction phase, the weather abruptly turned dry, and a narrow schedule window for
successful planting was closing rapidly. A decision was reached to irrigate the south basin sufficiently to permit planting in that basin, although it was not part of the original scope of work. The water for irrigation would need to be very low in salt content so that the specified plant species would survive, and the water in the lateral was greater than 5,000 mg/l salt content (a factor of at least 10 too high). A rapid options analysis resulted in procurement of water from the City of Pasadena fire water line on the south side of Red Bluff Road, in large part because the water could be made available rapidly. Approximately 20 million gallons of water were needed to fill the basin and saturate the soil beneath it. As soon as the basin reached saturation, planting activities commenced in the lower elevations. The basin was planted over 80% before the weather became too hot for high rates of plant survival to be achieved. Approximately 56,000 plants were placed at a spacing of 1.5 meters. Planting was completed in late May 2005. The areas of the design that were to be maintained as upland prairie were also sprigged in accordance with the terms of the permit.

The irrigation water was shut off in June 2005 due to the commencement of drought conditions, but the basin retained water throughout the summer in spite of only one significant rain event. The amount of plant “volunteer” growth was dramatic, and by the end of the summer, the open water area was minimal in the south basin. The north basin remained too dry to consider planting. Tallow control was achieved in this area by mowing. Tallow control of the site perimeter was implemented using herbicide applications.

Planting was intended to resume in September/October 2005, but the extended dry conditions did not permit any planting to occur because the north basin remained dry. While this would be expected under drought conditions in the conceptual design, since planting was part of the construction phase of the project, construction completion had to be postponed until spring 2006. Additional irrigation was considered but not implemented because it was beyond the initial project scope and would have raised costs considerably.

The drought continued over the winter, with only one significant rain event during the entire winter in December 2005. Aerial photographs of the property were taken on December 28, 2005, when the north basin pool height was approximately four inches below full pool. Infrared photography showed that the saturated soil area was adequate to meet the permit specified pool size.

Spring 2006 was also dry, with a few light rain events not providing sufficient water for significant planting. The south basin planting was completed and the deepest portion of the north basin was planted in bulrushes in one small corner (less than one acre). However, completion of planting activities was again postponed. The north basin was tilled to prevent tallow intrusion.

Commencing in June 2006, the drought ended and significant rain repeatedly filled both basins with water over the summer. Significant volunteer growth appeared in the north basin, chiefly Spikerush and Sagittarius. These seeds are likely to have come from the
south basin, since those plants had flowered abundantly in 2005. The remaining open wetland areas were planted in October 2006, and the initial stormwater control features (silt fence and high visibility fence and posts) were removed to complete the construction phase of the project.

The competition among the wetlands flora is already underway, with several planted species appearing in other areas and a general mixing of plant types. This is expected and healthy for the ecosystem, and is also expected to continue.

**ADVANTAGES OF DESIGN/BUILD APPROACH**

This project demonstrated several of the advantages of the design/build (D/B) approach:

1. Tight commencement schedule requirements could be met because pre-construction activities could commence before the design was approved. This saved at least eight weeks, not counting additional procurement time.
2. Required design changes could be made “on the fly” and permits could be obtained on the same basis. The stormwater quality management plan was assembled and approved rapidly, and the redesign was accomplished in two weeks. Both of these processes could have taken months under normal circumstances.
3. Changes in field conditions beyond the expected conditions (drought) could be addressed promptly, and the schedule adjusted accordingly. The need for and procurement of irrigation equipment and water was addressed in a matter of days. The extended drought that prevented planting the second basin was addressed by putting this phase of the work into hibernation until more suitable weather conditions occurred.
4. The additional costs incurred by the redesign, and the need for additional construction and irrigation, could be adjusted within the existing authorization for the entire project, minimizing the amount of paperwork required to track the project and the need for additional authorization. This would not have been possible under a task-specific line budget.

**LESSONS LEARNED**

The project team offers the following recommendations on performance of design/build (D/B) projects under a public agency contract. These are somewhat interlinked in practice.

1. *Don’t do it unless you have to.* While this project succeeded, there was considerable stress placed on both the PHA and the D/B team by operating in this mode. Most public agencies have a difficult time with changes to line item budgets, and the D/B process requires inherent operating flexibility. In this case, the permit conditions required that the D/B approach be applied, because the starting date for construction could not be met using any other contracting
mechanism. The risks of a lump sum approach were too high for the parties involved, and may not have solved the central schedule issue.

2. **The main thing is to keep the main thing the main thing.** In any D/B project, there are certain elements that are mandatory. These were identified in the kickoff meeting, and were reconsidered during every change process. Considerations such as permit compliance, cost containment and timely notifications were addressed regularly as the core elements that drove decisions.

3. **Too much communication is not enough.** This motto was communicated at the start of the kickoff meeting, and was repeated regularly during the project. The prime contractor MUST keep the client and the team members up to date on progress, problems, solutions and budget status. A large part of the project success was directly related to the atmosphere this regular, open communication created. One note is that e-mail became a very important communication tool; it kept all parties up to date very efficiently and allowed the additional side communications to occur with minimal distraction. This communication style and intensity required additional time, but the project would not have succeeded as well without it. Issues could be presented, addressed and resolved very rapidly in this environment.

4. **Build and maintain a team atmosphere.** The team members were generally familiar with each other prior to the start of this project, and the good start in communications helped maintain a team approach to solving the issues that arose. Also, the team roles were well defined at the start of the project, and the team members were empowered to perform their tasks by the prime contractor. This resulted in minimal schedule slippage in spite of the typical performance obstacles described above. A sense of humor on the part of all concerned parties helped this process considerably.

5. **Manage the changes and find team solutions.** As indicated above, there were numerous issues that prevented project execution from proceeding as originally planned. Good communications both within the team and within the PHA were a great help in preventing schedule slippage; without these methods in place, the project would likely have been at least a year behind the original schedule. The overall budget remained unchanged, as a result of this team approach to the change management process. A sense of patience during the change process, and a willingness to explore options sufficiently to be convinced that the proposed solution was the best one in the face of tight schedule constraints, resulted from this team approach.

6. **Communicate about money openly.** This is a critical part of the team atmosphere and communications in general: the financial impact of on-the-fly decisions must be understood during the decision process. This requires intense effort on the part of the entire team (particularly the client!), but the project would have stalled several times if this had not been practiced. The requirements of the PHA and the needs of the contractor team were addressed openly and team solutions were developed that satisfied all parties. There were only two amendments to the contract, and the total authorization was not changed in spite of all the operating and schedule changes.
7. **Cope with things you can’t control (e.g. weather).** This project was significantly impacted by weather and climate conditions, and faced the most difficult climate conditions at all stages of work (wet during construction, dry and hot when planting was scheduled). Other non-controllable issues included personnel status changes, scope changes that resulted from the redesign and climate conditions, and additional permitting requirements. Project financial control mechanisms were practiced by all team members to minimize costs during delays and honor the contract requirements.

**SUMMARY**

The project described above was regarded as a success by all the participating team members, and the client is pleased with the outcome. The resulting wetlands are both highly functional and beautiful. While the execution of the project did not proceed as originally planned, the flexibility that the D/B approach provided, and the cooperation achieved by the entire project team including the client, led to a successful outcome for all parties. The lessons learned should apply to other projects, whether they are executed on a D/B basis or the conventional design/bid/build format.