San Luis Obispo Botanical Garden Bridge Rebuild

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Abstract

This paper will outline the process of designing, deconstructing, and reconstructing a utility bridge at the San Luis Obispo Botanical Garden. The San Luis Obispo Botanical Garden’s entrance was recently changed deeper into the property. The old entrance was at the front and was home to a bridge utilized by staff, volunteers, and visitors alike. This project’s goal was to rebuild the utility bridge so that it could be used by the facilities staff and volunteers when working on property. There was one student involved in this project who acted as the designer, performed the preconstruction work, and constructed the bridge as well. The design and preconstruction of the bridge was done prior to the plans being approved and procuring the material. The deconstruction and construction phase were focused on the logistics of building the bridge and ensuring it was done on-time, within budget, and to plan. The design phase began by coordinating a schematic design with the garden’s executive team and planning a realistic design that would be shown with details and specifications. This paper will cover the entire process of the project from before and after.

Key Words: Botanical, Bridge, Garden, Rebuild, Volunteer

Background

The San Luis Obispo Botanical Garden is located along Highway 1 between San Luis Obispo and Morro Bay, across from Camp San Luis Obispo and Cuesta College, and in El Chorro Regional Park. With 150 acres, the garden is devoted to ecosystems and plants native to the world’s five Mediterranean climate regions. As a non-profit botanical garden, their mission is to honor and preserve our connection with nature. That said, volunteer opportunities are endless; some needs include garden maintenance, marketing/photography, facilities maintenance, and office assistance.

This project-based project was built at the old garden entrance as a volunteer opportunity with the garden’s facilities maintenance. The previous entrance involved a bridge that was older and rotting away. It was no longer safe for visitors, volunteers, or staff to drive or walk across the bridge. So, the garden decided it needed the bridge rebuilt.

Plans for the bridge were drafted and then reviewed and approved by the garden’s Director, Chenda Lor and Maintenance Engineer, Steve Brown. The schedule to complete the project was the duration of one quarter at Cal Poly, or ten weeks. Within that time frame, the existing bridge first had to be demolished and then rebuilt according to the approved plans.

Process Steps and Deliverables

Design
The plans were originally a request for proposal including a summary of the proposed costs and construction documents for the reconstruction of what will now be the maintenance access bridge at the garden’s entry. They were reviewed and approved by Chenda Lor, Director and Steve Brown, Maintenance Engineer. Within them was a cost estimate of material with line items, unit prices, units, quantities, all subtotals, contingency of 5%, and a total at the bottom. The estimated cost of material was $2,100. The plans were also rendered to mimic the previous infrastructure of the bridge. There was to be a CMU retaining wall constructed at the left side of the bridge to prevent erosion to the newly built bridge. Plans then called for concrete to be formed and poured for the future installation of beams that would run across the bridge. Once the beams were installed, they were to be fastened with bolts to the concrete to ensure stability as the build continued. After, boards were to be laid perpendicularly across the beams to create a flat surface for people to walk and drive on. A kicker was also needed for ADA compliance and safety for those in need when using the bridge. Details on all aspects above were drafted to ensure the quality of the bridge. The original plans and renderings for the bridge are displayed below.
For the new bridge to be built, the old bridge had to be demolished. It was decided that the old bridge would be deconstructed to save as much as the old material as possible. This was to fit the theme of the property and show respect to the environment and sustainability. Deconstruction started with a drill and bits to remove old screws that fastened the boards to the beams. There was a mixture of screws and nails used in the old bridge. Though the drill could remove the screws, it could not remove the nails. So, a hammer and crowbar were implemented into the process to easily remove the nails and therefore the boards from the beams. Once all boards were removed and laid down in storage it was on to the beams. The beams were surprisingly not fastened to the previous infrastructure. This is partly because the old infrastructure was rotting away and the anchor bolts that once held the beams in place were rusted and could no longer fasten anything together. The beams were removed, loaded in the truck, and placed in storage with the boards. To finish deconstruction, all debris and trash was cleaned, and reconstruction was ready to proceed.
Construction

Construction could only commence once the ground was graded properly to fit the new bridge. To start, the CMU blocks needed for the new retaining wall were not purchased by the garden because they decided it was not necessary for the project. Moving forward, a rake and shovel were used to grade the soil and rock properly for the water runoff not to be affected and for a level ground to allow the beams to rest on.

Once grading was finished, the concrete was to be formed and pour for future beam attachment. However, the garden decided not to purchase the concrete and anchor bolts that the beams were to be attached too. So, the new pressure treated beams were cut to length, notched to avoid future damage to a water pipe, put to an appropriate spacing on center, leveled, and fastened to the previous infrastructure via large screws ton nailed on each side of each beam. With the material that was purchased, there was only enough lumber to cut 5 beams. The rest was decided to be used as bracing between beams and act as resistance to overturning or rotation. Though not called for in the plans, the braces were tough and suitable enough to act as the concrete and anchor bolts that were omitted.
The next step in the construction stage was to fasten the boards to the newly built bridge frame. There were only 13 boards purchased by the garden which was not enough to span the full length of the bridge. The original idea was to space the boards 3/4 of an inch from each other, but that amount of spacing looked to be too much. Instead, a half sized previously used for fencing was found and used on one end of the bridge to bring the spacing down to 7/16 of an inch instead. The new board spacing looked much better, more uniform, and like a typical wood bridge should look. To make sure that the quality of the build continued, a chalk line was used along the top of the boards and middle of each beam spanning the length of the bridge. Deck screws were then used along the line to fasten the boards to the frame. Once fastened, the boards were cut to the exact width of the bridge for a nice straight look.
The final touch was to install the metal kicker for along the sides of the bridge as called out in the plans. However, it was discovered that the metal kicker was never purchased. The garden wanted to move forward with a different design using pressure treated fence 4x4 fence post. The posts were laid the span of the bridge and cut to the proper length. To add an architectural look to the kicker, a chamfered/angled cut was taken out of the ends. The kicker was then fastened through the boards and to the outside beams of the bridge. Thus, the bridge became complete.

Lessons Learned

When it comes to construction, each project is going to encounter unique challenges, such as design changes, manpower issues, and material shortages. Though this bridge was completed on time, below budget, and structurally sound, it provided and reinforced unique learning experiences in all three of those aspects of construction. For instance, the owner didn’t see a need for the retaining wall or concrete for the beams to be anchored to. Thus, they opted not to purchase the proposed material. Many aspects of the original project design were changed from the original plans. I learned that no matter what the plans call for, it only matters what the owner decides they want in the end. Also,
numerous on-the-fly decisions must be made during the construction process when these design changes are requested.

The deconstruction portion of the build was the most difficult. This is due in part because I was the sole person performing this project. There was a huge delay in the schedule because I had pulled the muscles in my back due to overstraining it while attempting to pry the boards off the beams. I was out for a few weeks enabling my back to heal before resuming work. This made me realize how important manpower is for not only getting the job done on time, but safely as well. If I had another worker with me, I could have saved myself the pain and delay.

When it came to the construction portion of the project, the biggest difficulty was that not all the material from the plans was purchased. This was surprising because the original project design was approved by the garden’s administration. This led to further design changes and having to come up with building solutions on the fly. For example, the kicker was originally supposed to be made with metal angle. However, since this was not purchased, the garden approved two 4x4 fence posts to be used and act as the kicker to serve its original purpose. The lesson there was that there can be another way to perform a task and construction is never perfect according to the plans.