

San Luis Obispo Botanical Garden Benches

Brandon Keefer

California Polytechnic State University
San Luis Obispo, California

The San Luis Obispo Botanical Garden is an outdoor area where people often gather for events such as weddings or just simply for a casual stroll through nice scenery. There were 6 students, including myself, who teamed up to complete this project where we divided into two sub-teams, one design team and one construction team. Since I was assigned to be the team captain but was placed on the construction team, I will touch a little bit on the design process since I was involved with overseeing this aspect but focus mainly on the actual construction of the benches. This project went through several challenges at each stage of the process, from figuring out a design that the owner liked that we could build to figuring out the site logistics and how we would construct the benches. This was a very valuable experience with a lot of lessons learned such as coming up with construction drawings of our design, how important it is to know who the best person to reach out to is, and even how to operate a concrete truck with no previous experience in tight work areas.

Key Words: Benches, Wood, Concrete, Formwork, Rebar

Introduction

The San Luis Obispo Botanical Garden was founded in 1989 by an Ornamental Horticulture major here at Cal Poly named Eve Vigil. The garden then became a nonprofit organization two years later in 1991 and due to the fact that they have so much land to manage, they are always looking for a little bit of help with projects to help attract visitors and locals of the area. They contacted the Construction Management department asking if anyone would be interested in making their idea become a reality through someone's senior project. This is where Kyler Cruz, Makenna Gitchell, Anthony Masarweh, Devon Bartmaier, Sydnee Greer, and I came into play. Their idea for our senior project was to liven up their amphitheater with enough seating for them to rent out to people for weddings or other similar events. We knew that this project would cost more than what the Botanical Garden had so once we

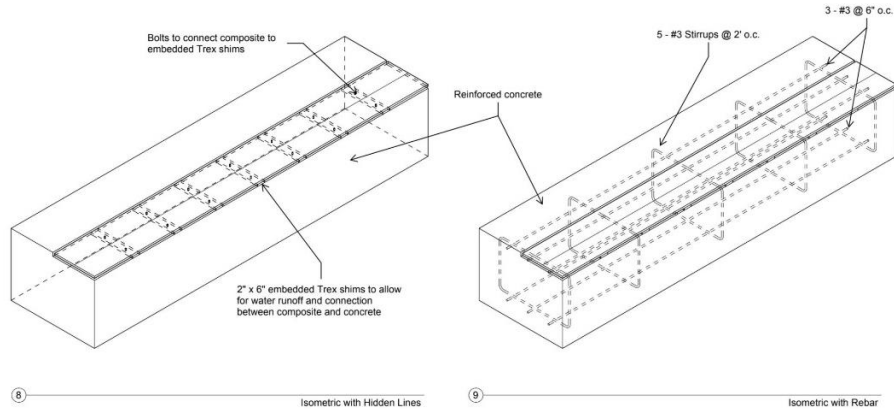


Figure 2. Isometric drawings including Trex seat and rebar

Construction of the Formwork

To start the build of the benches, we had placed an order at Hayward Lumber in San Luis Obispo for delivery of our plywood and 2x4's. The plywood that we had ordered was a special kind of plywood that is used specifically for placing concrete called alform. This plywood has a smooth side where the concrete is placed and then a normal plywood side that is the outside of the formwork. Before we started hacking away at the gold-worthy wood we had in front of us, the construction group of our team, including myself, came up with a cut sheet of all of our cuts for the plywood so that we would utilize the wood the most efficiently and have the least amount of scrap. After figuring out the two long sides would come from one sheet of plywood with the scrap left over to be used as our edge for the indent in the middle of the bench and six of the side panels would come from another sheet, we started the build of our formwork. When all of the long sides, bottom sheet, and side panels were finished being cut, we then started attaching all of the pieces together by laying out everything as if the box were unfolded. (Figure 3.)

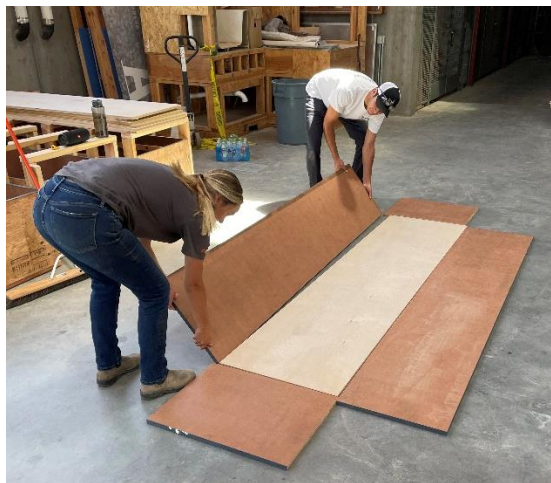


Figure 3. Formwork unfolded

Following the build of our formwork boxes, we then dove into the 2x4's that would then be our bracing. When we had originally estimated the 2x4 bracing for the benches, we didn't have a good idea of how much bracing we would need since there was so much concrete being placed into the boxes. Our original plan was to line the perimeter of our benches twice at different heights up the box. After speaking with Dan Knight, one of our project advisors who has a lot of experience in the concrete world, he informed us that we would need much more 2x4's for our bracing because we would need to have them placed vertically on the boxes every 16 inches on center. When we thought we finished constructing the formwork boxes with the appropriate bracing, we talked with Vince who works at the concrete yard and he explained to us that we would need more 2x4's that were placed horizontally with the 1-1/2 inch side of the board running around the perimeter of our formwork because it would give the vertical boards bracing so that the sides of the formwork wouldn't bow out. We then had to estimate how much more 2x4 boards we would need due to both criteria we had just been given. After estimating a total of 31 16-foot boards we would need in addition to the boards we already had, we made our way back to Hayward Lumber to pick up the material. (Figure 4.)



Figure 4. Picking up more 2x4's at Hayward Lumber

When getting back to the Simpson Strong Tie building with the 31 sticks of 2x4's, Anthony, Kyler, and I figured out a way of cutting the sticks into our desired length the most efficiently. Setting up a table saw right by the truck so we could slide the sticks off the truck and onto the table saw, we set one of the bars on the end of the table saw to be the length of cut we needed from the blade. Once this was set, all we had to do was slide the 2x4 off the truck and onto the table saw then chop through the wood. There wasn't any need to mark up every individual piece with the cuts that we needed and since the lengths were 24 inches and 28-3/4 inches, there would have been a lot of marking up to do. What would've taken about 3 or 4 hours to mark up and cut each stick, we were able to cut all of the boards in about 30 minutes. (Figure 5.)



Figure 5. Boxes with 2x4 bracing

Building the Rebar Cages

To add a little bit of structural value to the benches, we designed rebar cages as seen in the isometric drawing in Figure 2. When we ordered the rebar from Air Vol Block here in San Luis Obispo, we ordered straight sticks of #3 rebar and had them prefabricate the stirrups as shown in that isometric drawing. The straight sticks came in 8-foot lengths which we then had to cut down a little over 6 inches from to get the required 3 inch clearance necessary from the end of a piece of rebar to the end of concrete. Once this was all done, we looped four of the stirrups over a long piece of 2x4 we had set aside for this process of tying the rebar cages. We then ran 3 of the straight stick of rebar through the square and tied each individual stick to the stirrups, flipped it over and repeated that same process. (Figure 6.)

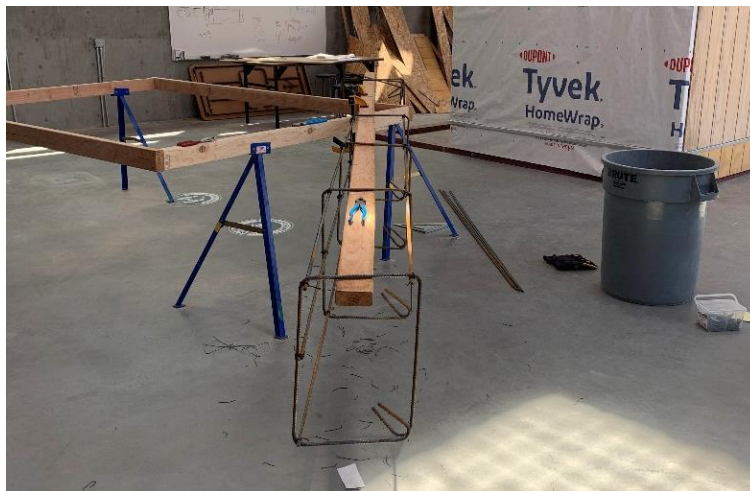


Figure 6. Tying the rebar cages using a 2x4 board

Mobilization of the Benches

Getting the benches delivered over to the Botanical Garden was my main portion of the project where I had to figure out the logistics of what we will be using to drive them over there, what equipment we would need that would work with such a tight area where we would be dropping them off, and how we would unload and place the benches.

The first step I took in this process was going to the area of the garden where the benches will be placed and figuring out what the smallest width of pathway is because we would need some kind of forklift to rent in order to unload and place them. Once I found this, I contacted several different rental companies asking them if they had anything that would work that had the proper carrying capacity and width that would be able to maneuver with a bench on the forks in the garden area. Since the forklift would be driving over pavers that have been there for several decades, we used sheets of scrap plywood that we saved from the formwork to lay down so that one, the forklift wouldn't get stuck but two, so that the weight of the 9,000-pound forklift wouldn't destroy their beloved pavers.

The next step was to find a trailer that was long enough so that the benches could be placed evenly width wise on the trailer and also have enough of a carrying capacity. In unison with this, we had to track down a truck that would be able to properly tow the trailer and desired number of benches for the size of trailer. I found this to be a little bit of a balancing act because I hadn't had much experience figuring out the tow rating of trucks but was able to successfully find one that worked.

Finally, after our forklift was scheduled for delivery and trailer was reserved for pickup, the next process was our layout plan of how we would phase the unload of the benches. Working furthest from the trail back, we placed each bench. Beforehand, we had used duct tape for the pavers and spray paint for the decomposed granite section to properly layout the area according to our site plan in Figure 1.



Figure 7. Benches laid out

The final touches made to the bench were done once we had everything set in place and knew that we wouldn't be moving them ever again, hopefully. Towards the end of the process of building the formwork, Sydnee had teamed up with members of the CAED Support Shop to pour bronze plaques that read Cal Poly "Construction Management 2021" as shown in Figure 8 below. Each bench was given a plaque where we used an epoxy to attach them to the benches. The other final touch up of our benches once they were in place was identifying areas that needed to be touched up with a slurry seal coat that consisted of cement, water, sand, and a binder.



Figure 8. Bronze plaque for benches

Lessons Learned

When this project was complete there were several different lessons that I personally learned along the way. The first being during the design process that I should have gone to the city planning department in the area to talk to them about whether or not we would need a permit for this kind of project, which we did end up needing and found out the week before we were planning on delivering them. The second lesson I learned was that, being in a leadership position, it's a lot easier to stay focused on the end goal when you know how to delegate work to others who's job or role of the team is specific to that. When miscellaneous tasks came up throughout the project, it was easier for me to do those myself than to delegate them onto someone else. The last, yet biggest lesson that I learned was that when being a team captain, you earn a lot of respect from those who are relying on you when you are the first to jump on doing the dirty work that most likely nobody else wants to do. When the team sees someone that they rely on doing the dirty work or putting in the extra hours of work to get the job done, it builds an environment where the team gains respect for you but also makes them realize that no matter what role they have on the team, nobody is considered "too big" for the job.