Design of Amphitheatre Seating at the SLO Botanical Garden

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This senior project was designed to provide a gathering space for the San Luis Obispo community. With the San Luis Obispo Botanical Garden providing an outdoor space for nature education, wedding ceremonies, and several other types of gatherings, they wanted amphitheater seating for forty guests. This project required the design and construction of ten concrete benches that span eight feet with wood Trex added on top for comfort. The focus of this paper will be on the design process of this project. When designing the benches, the Botanical Garden wanted seating that could withstand the elements but still be comfortable and inviting to those who visit. The benches were drawn using a 3D program called Rhino, then edited and compiled in Bluebeam. Once all drawings were compiled, we created a plan set that was then sent to the city of San Luis Obispo for approval. The project was then handed off to the construction and installation team. Our goal for this amphitheater is to help the Botanical Garden further its reach and impact in the San Luis Obispo community as a local nonprofit.

Key Words: Concrete Benches, Seating, Design, Trex, Rhino

Background

This project is located at the San Luis Obispo Botanical Garden (SLO BG) off of Dairy Creek Road in the city of San Luis Obispo. This 150-acre garden is a nonprofit organization that strives to honor and preserve our connection with nature. The idea for a botanical garden in San Luis Obispo came from a California Polytechnic State University (Cal Poly) student back in 1989. Student, Eve Vigil, worked with Cal Poly lecturer, Joseph Donaldson, to create a botanical garden based on the five Mediterranean climate zones of the world. The “Friends of the San Luis Obispo Botanical Garden” was officially incorporated as a nonprofit organization in 1991.

The garden’s vision is to educate and inspire people to connect with nature, enjoy outdoor recreation, increase community interaction, and support botanical collections and horticulture research. In order
to do so, SLO BG wanted an amphitheater-like space to host educational classes and ceremonies. Once the need for this project was brought to the Cal Poly Construction Management department, students Devon Barthmaier, Kyler Cruz, Makenna Gitchell, Sydnee Greer, Brandon Keefer, and Anthony Masarweh met with SLO BG to develop a plan.

It was decided between SLO BG and the Cal Poly Construction Management students that the type of seating would be concrete benches with wood aspects for comfort. The plan was to construct ten benches that could provide seating for forty people. This amphitheater will give SLO BG the space that they have long desired, a space for the San Luis Obispo community to reconnect with nature.

Process

First, the six Cal Poly students were split into teams based off of their interests and strengths. Brandon Keefer was named team captain and he was responsible for checking in on deliverables and ensuring we were all meeting our deadlines. Anthony Masarweh was the liaison between the gardens and the project team. We thought it would be best to have one point of contact, so information was accurately relayed on both ends. With extensive knowledge on virtual design programs, Devon Barthmaier and I, Sydnee Greer, took lead as the design team. We were responsible for the design of the benches and the site layout. Kyler Cruz, Makenna Gitchell, Brandon Keefer and Anthony Masarweh took lead as the construction team and were responsible for estimating, ordering materials, and constructing the bench formwork. We all helped with constructing the formwork and pouring the benches.

Once everyone was assigned to their respective tasks, we would work on our own time and meet once a week to check in on deliverables. We had design meetings with SLO BG about once a week for the first three weeks of the project to make sure we were all understanding exactly what the garden’s wanted for their final product. The first three to four weeks of the project were spent finalizing the bench design and layout. We then spent a week and a half constructing the bench formwork and then poured all ten benches in one day. Once the benches were poured and cured, we stripped the forms and connected the Trex to the embeds that we placed during the pour.

Deliverables

Schematic Design and Drawings

A schematic design of the benches was developed to give SLO BG a first look at what the benches would look like. In order to come up with a design, we went to the gardens and looked at the space. The garden representatives in charge of the project explained that they wanted eight-foot benches so they could seat three to four people per bench. They also said they wanted the benches to be made out of concrete rather than wood because concrete required less maintenance and could withstand the elements. The only issue with the concrete benches was lack of comfort, so as a design team we decided to add Trex board across the top of the bench. This way, we accomplished both durability and comfort. Once the dimensions of the benches were finalized, we moved on to develop a site plan.

Site Plan
An overall site plan of the bench layout was requested from SLO BG so they could see the best way to use the space. We went back to the site to take measurements of the area we were working with. Some of the key elements we wanted to accomplish as a design team was to maximize the space and ensure the layout was designed with purpose. The walkways needed to flow well and the spacing of the benches needed to feel comfortable without feeling overcrowded. Once we had a rough layout of the space in Revit, we scaled the benches in and added ADA compliance spacing and walkways. We came up with three different layout options and then presented them to SLO BG. Once they picked one, we moved on to creating a plan set.

**Plan Set**

We felt that a plan set would be necessary for this project. This way, SLO BG would have a good understanding of exactly what we were doing. It also allowed for the construction team to have all the dimensions on hand while they built the formwork. The finalized plan set consisted of six sheets: a site layout, plan view drawings of the benches, elevations of the benches, isometric views, and construction isometric views showing rebar. All of the 3D drawings were made in Rhino and then compiled and edited in Bluebeam.

**Bronze Plaques**

Lastly, the design team was tasked with creating a plaque for each bench. With the help of the College of Architecture and Environmental Design Support Shop, we were able to cast ten bronze plaques. We had to create a 3D model of the plaques in Rhino so we could 3D print them in the DFAB lab. We then invested them in jewelry investment material and put them in the kiln for 24 hrs. Once the molds were complete, we poured molten metal into the molds and allowed them to harden. After the plaques were casted and cooled, we sanded them down and painted them to get our final finished product.

**Lessons Learned**

**Americans with Disabilities Act Standards for Accessible Design**

One of the biggest take-aways from the design side was learning about Americans with Disabilities Act (ADA) Standards and Compliances. When creating an inclusive space, one must take these compliances into account. We had to make sure the center isle between benches met these requirements as well as the spacing between benches. We wanted to make sure the space was easily accessible for everyone who visits. This just required us to do research for the proper spacings and alter designs to meet these requirements. Overall, it doesn’t add much time to the project, but it is very important that the compliances are met or exceeded for any project.

**Time Constraints**

Another lesson learned was issues with time constraints. Ideally, the design process for a project of this scope should have started a quarter before the construction phase. The beginning of the design phase seemed very rushed and stressful. Knowing we only had ten weeks to complete the entire project, it didn’t seem doable. The first four weeks of the project were spent going back and forth on bench design and site layout leaving only five weeks to estimate materials, order materials and
equipment, build the formwork, pour the benches, strip formwork, and install the Trex. Luckily, we were able to complete the project on-time, but if any of those processes had been delayed, we would not have finished the project before graduation. It would be in everyone’s best interest to start the design process the quarter before so there’s more time between deadlines. A lot of things like deliveries and material availability are out of your control, so it is important to leave float in case materials don’t arrive on-time.

**Weight Constraints**

The design of the benches required a solid concrete core, so we decided to add foam to the center of the benches to take up space and reduce the weight. Even with the foam, the benches weight became an issue. Because they are so heavy, the equipment required to move them needed to be bigger, therefore, it was more expensive. This also made getting them onsite more difficult because the site is hard to access with large equipment. We were able to give SLO BG the exact benches they wanted but, from a design perspective, there should have been a few changes made. To make the benches more moveable, I would have either added legs to the design to take away the solid concrete center, or I would have made the benches smaller, possibly four feet long, to decrease the weight. Even though the design worked, it added challenges that could have been avoided if we had paid more attention to the weight of the benches.

**Conclusion**

Although we faced several challenges, this project was very successful. We were able to collaborate as a team and give the San Luis Obispo Botanical Gardens exactly what they had hoped for. We learned many lessons along the way due to COVID-19, permitting, time constraints, and compliances, but overall, we completed the project on-time and within budget. While this was a large project, we were able to divide the work amongst us in order to get it all done. Thank you to all who contributed their time and effort, we can’t wait for the community to enjoy the beautiful Botanical Gardens.
Appendix and Figures

Figure 1. Schematic Drawing of Bench Design

Figure 2. Amphitheatre Bench Elevations
Figure 3. Site Plan and Bench Layout
Figure 4b. Plan Set Plan View of Benches
Figure 6. Poured Benches Showing Trex Embeds and Depression
Figure 7. Metal Casted Bronze Plaques

References
