

San Luis Obispo Botanical Garden Amphitheater Benches – The Design

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This paper will outline the process of designing, building, and installing ten concrete benches at the San Luis Obispo Botanical Gardens with an emphasis on the design phase. The San Luis Obispo Botanical Gardens is home to an amphitheater that is used for event spaces. The goal of the project was to create a design to seat approximately forty people facing the stage. The project group consisted of six students broken into two teams, a pre-construction team and a construction team. The preconstruction team focused on designing the benches and procuring the materials while the construction team focused on the logistics of building the benches off-site and bringing them to the garden. The design phase began by coordinating a schematic design with the employees of the garden and planning a realistic design that would be shown in plan, elevation, and isometric views. This paper will cover the entire process of the project with a primary focus on the stages of design.

Key Words: Design, Concrete, Benches, Coordination, Digital Drawing

Background

This project-based project is located in the San Luis Obispo Botanical Gardens in San Luis Obispo, California. The SLO Botanical Gardens consists of 150 acres of land home to several native and non-native plant species. Each of the garden spaces is meant to be interactive with the public through use of seating, information or viewing. The SLO Botanical Gardens is a non-profit that was started as a Cal Poly senior project in 1989. Since that time, there have been several senior projects and volunteer work completed within the gardens. Specific to this project, the SLO Botanical Gardens team reached out to Cal Poly's Construction Management department in search of a team to design, build, and install seating in one of the amphitheater locations. At approximately 1,000 square feet, the amphitheater has a stage and surrounding foliage on site. The amphitheater is used for events such as weddings, classes, and private parties, so the vision was to create seating facing the stage for forty guests. Once the site was visited and the project understood by our team, the pre-construction and design work began.

Design

Schematic Design

The design process begins by consulting with the client to understand the wants and needs of the project. The project required seating for forty people in an amphitheater style. Due to the lack of funding for the gardens, the client preferred the seating was made from a material that would require little maintenance. Our team decided on reinforced concrete benches due to its weatherability. Once the client's vision was understood by the design team, photos of previous bench designs were researched to narrow down the style. The design team met with the client on-site and via Zoom many times in the beginning to continue discussing the project parameters. Ultimately, the final design selected consisted of ten eight-foot-long concrete benches.

Site Plan

The site plan is one of the most important drawings in the final set. It gives an accurate depiction of the site's dimensions and elevations. The process for starting the site plan drawing begins with measuring the "as built" dimensions of the site. The 1,000 square foot site was broken into two main sections, one made from tri-cobble concrete pavers and the other from decomposed granite walk. In between the two sections was a planter that the design team ultimately decided would need to be removed. After measuring the site and beginning to layout the dimensions on digital paper, the next step was to lay out the specific location of the benches. At eight feet long, it was assumed that approximately four people could fit on each bench, which is how the team decided on ten in total. Based upon the nature of the final design and the tight deadline of the project, the benches needed to be placed on one solid material without crossing onto another surface. The flat, concrete block style of the benches would not sit flat had they crossed over two materials. Sydney Greer drew up two proposals for bench profile locations and presented it to the client. After several Zoom meetings with the client, a final layout was chosen, so we began to create the specific design of the benches.

Working Design

Once the site plan was drawn and the size parameters of the benches were decided, the design phase began. The design was digitally modeled and drawn in Rhinoceros, Adobe Illustrator, and Revit. Rhinoceros was used in the beginning to efficiently design with creative freedom. From there, 2D drawings of the 3D model were exported to present to the client. The process consisted of several iterations of 2D drawing presentations until one final design was chosen. Although the required dimensions were known going into the design phase, there were several options for the aesthetic look of the benches. Once the final design was selected, Revit was used to 3D model with building materials in mind to help the client visualize what the benches were going to look like.

Final Design

The final design consists of concrete blocks with a composite wood finish on the front half of the top of the bench. The reinforced concrete has a depression in it to support the composite wood and allow it to have a flat finish with the concrete. Reinforced concrete was chosen as the primary building material because it requires little to no maintenance for the SLO Botanical Gardens. However, concrete is traditionally a cool material, so the design team decided on adding the composite wood finish to create a natural warmth for more comfortable seating. The block design was chosen for ease of structural capabilities. Once the architectural portion of the design was complete, a consultation

was scheduled with structural engineers about proper rebar use to ensure structural stability. The engineers assisted with designing a rebar cage that would be placed inside of the benches. In addition, the engineers were concerned with the volume of concrete that was planned due to its heavy weight and suggested the team add a foam block inside the rebar cage to reduce the weight of the benches. Once the architectural and structural engineering was complete, construction could commence.

In order to properly convey the final design of the project, several drawings are required including a plan view, elevations, and isometric drawings. These drawings are used for permitting purposes and to assist the construction team during the build phase. The plan view drawing shows one bench from an aerial view to understand the dimensions and one to understand the placement and orientation of the rebar cage. The elevation view drawing shows one bench from both sides to understand its relationship to the ground, the dimensions, and the placement and orientation of the rebar cage. The isometric view drawings show a 3D view of one bench to understand the materials and overall design of the benches. The final drawing set consisted of five drawings that provide all the information needed to properly build and install the benches.

Construction

Ultimately, the design phase of the project took longer than anticipated, leaving little time for error during construction. Construction began by making the formwork of the benches. Once the formwork was complete, concrete could be poured and left to properly cure. After curing, the forms were stripped, and the composite lumber was prepared to be added to the benches. The construction team placed wooden shims on the depression of the benches to allow for the composite wood to be installed and secured. On the concrete side of the bench seat, another depression was left for a plaque to be placed to give credit to Cal Poly for the project. The plaques were added after installation of the benches. Overall, the construction team worked very hard to ensure the benches were complete to the standard of the drawings and timeliness of the schedule.

Installation

At the beginning of this project, we were under the impression that we could pour the benches on site. However, upon learning more about permitting requirements and per the wishes of the garden's management team, we discovered that we would have to pour the benches off-site and have them delivered. This was an additional scope of work we were not prepared for in terms of labor or cost. We had to find a location that the benches could be poured and stored for curing. Additionally, we had to acquire the necessary materials to have the benches delivered and placed on site. Luckily, the College of Architecture and Environmental Design's shop allowed us to use the concrete yard to pour. We had help from Cal Poly staff to get the benches placed on a trailer, and one of our advisors who is a forklift operator, was able to move the benches from the trailer to their location in the garden. We placed markers on site to ensure the benches would be installed properly. The forklift set the benches from the front of the amphitheater to the back to ensure enough working room. The SLO Botanical Gardens requested that the benches be installed in one day to limit the amount of the time that section of the gardens needed to be closed to the public. On installation day, we made the executive decision to slightly change the layout of the benches. Unexpectedly, we were advised that day that a maintenance cart would need to be able to drive between and around the benches, which was not a dimension requirement previously known to us. Luckily, the change was relatively minor and only required that one of the benches be relocated to another location at the gardens. Ultimately, the

planned seating of forty may not have been met, but overall, the benches looked great in their final location and both our team and the client were happy.

Lessons Learned

This project included a wide scope of work to be completed in a short deadline, providing little time for the challenges of delay. With that said, we encountered many roadblocks along the way that required solutions. One of the first major lessons we learned was how to efficiently work with our clients. During one of the first meetings, we realized the clients were not in agreement with each other about what they wanted for the design of the benches. We met with the garden director, the team in charge of the volunteer program, and the head of maintenance, all of whom had different visions for the benches. Ultimately, we learned that sometimes it is beneficial for the client to have further developed designs to choose from rather than trying to design with them from scratch.

After coming up with the final design, there were other problems we faced. For example, in the beginning, it was unknown to our team that the drawings would need to be permitted and stamped by a licensed professional. This requires an additional advancement in the level of drawing detail. This was the first time our pre-construction team had finished drawings to be permitted, which meant there was a learning curve at each step to completion. If we had known this, we could have worked with the licensed professional earlier in the process.

Conclusion

In conclusion, the project specifications were met, and the benches were successfully designed, built, and installed on site. There were several lessons learned during each stage of this short project duration. Both the pre-construction and construction teams can take what they learned from this project and apply it towards their professional careers. With the help of the clients, our advisors, and other professionals, we were able to overcome the challenges we faced and provide the San Luis Obispo Botanical Gardens with ten benches that will be used for many years to come.

Photos

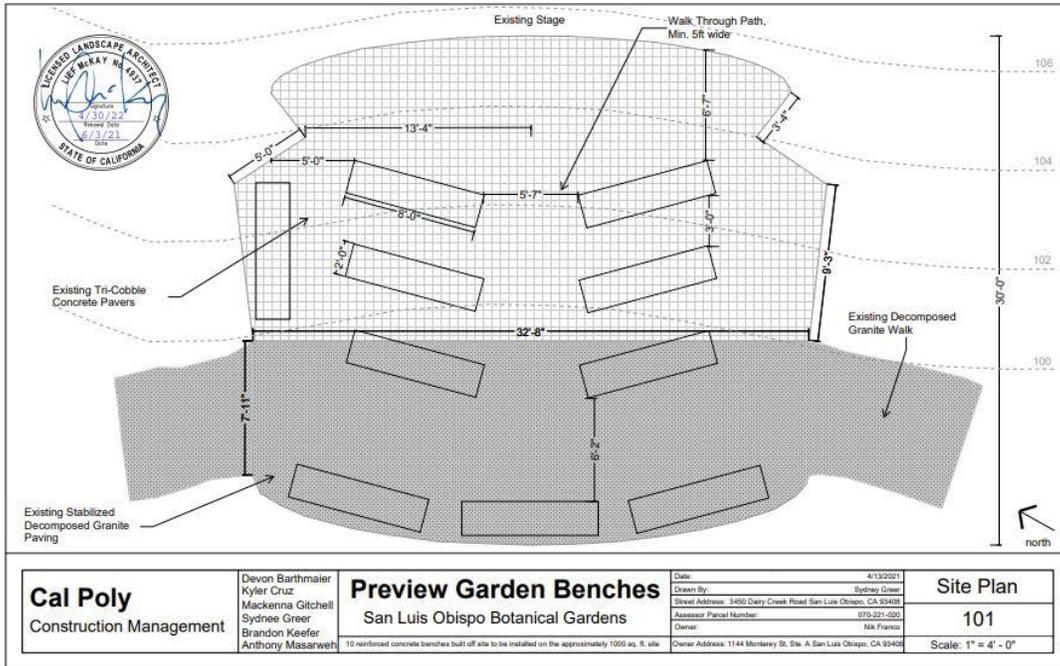


Figure A – Site Plan

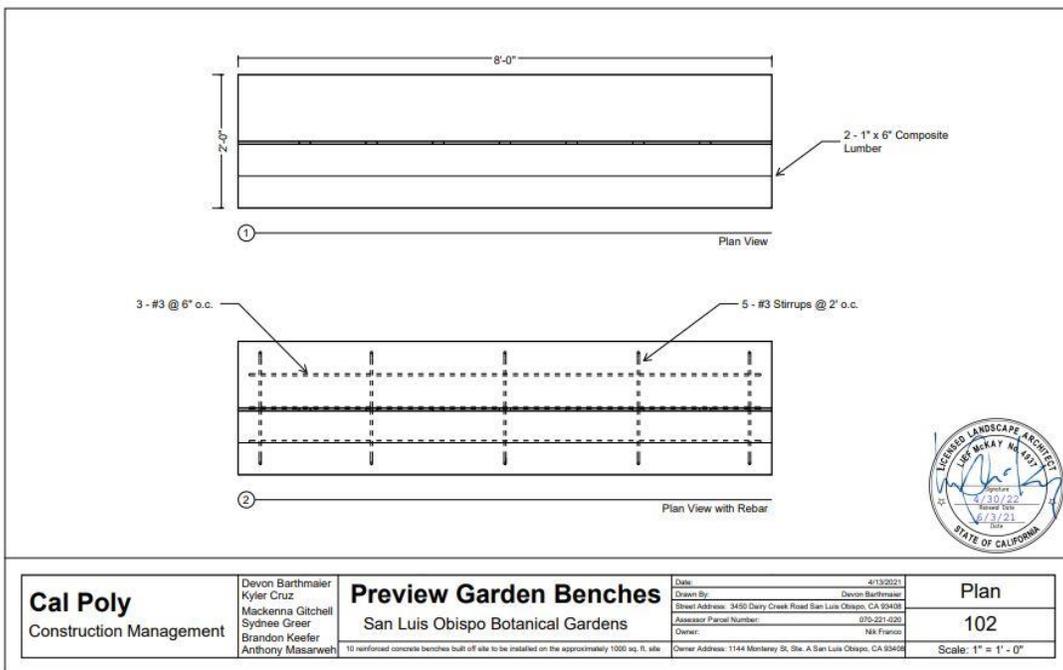


Figure B – Plan

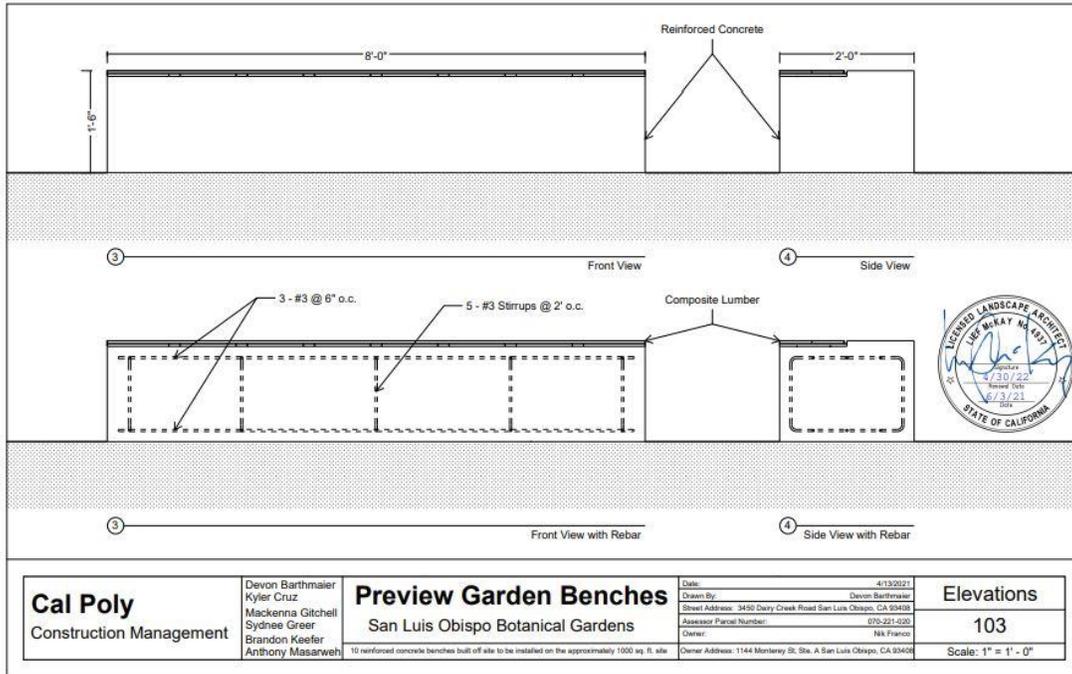


Figure C – Elevations

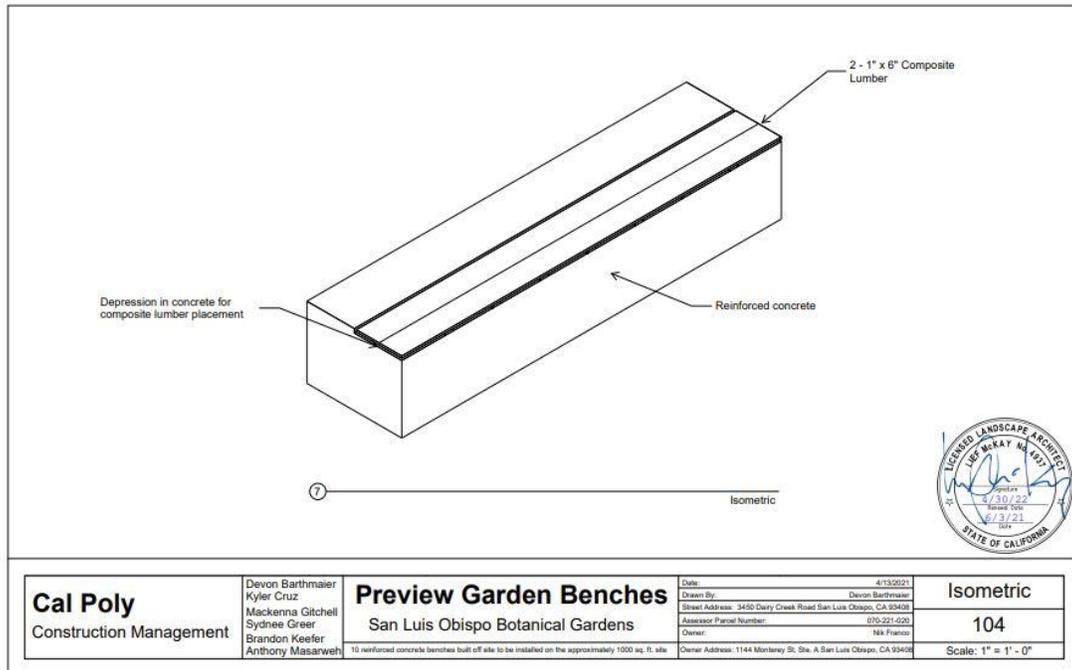


Figure D – Isometric

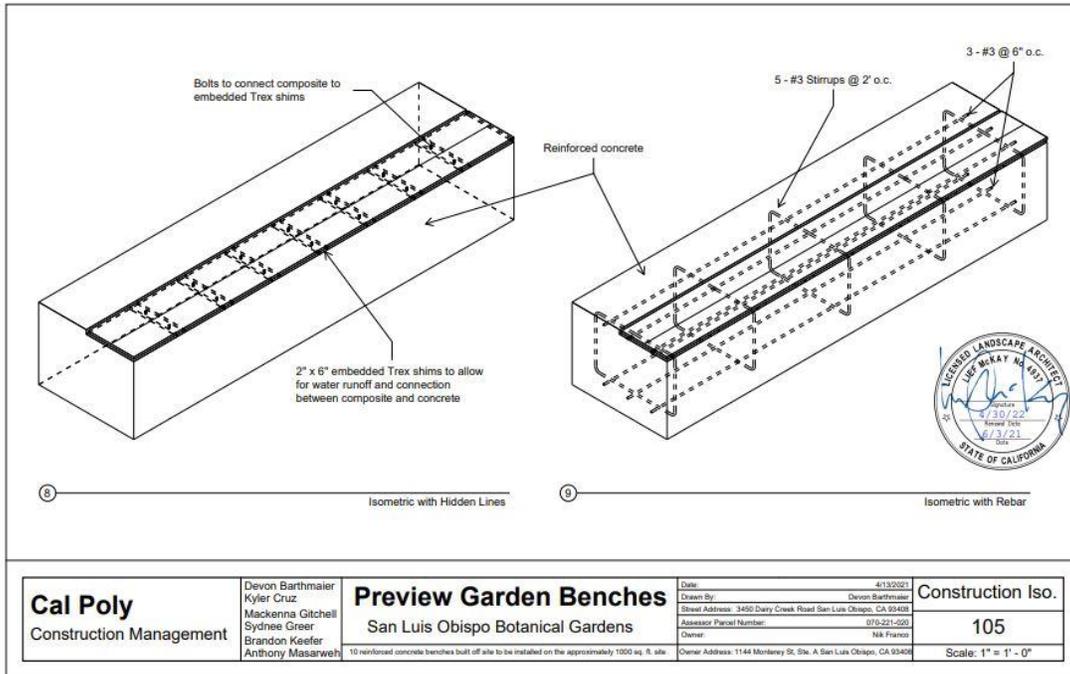


Figure E – Construction Isometric



Figure F – Final Design