

Paso Robles Police Department Shooting Range Shade Structure

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The Paso Robles Police Department has a shooting range about ten minutes from their station next to the Paso Robles Regional Airfield. They have owned the property for years, making numerous improvements to the land and infrastructure to make it more conducive to shooting, much of the work has been done by other past Cal Poly students as well. With Paso Robles geographical location, it is regularly a windy place where the average high during the summer months is almost 90 degrees Fahrenheit. Naturally when spending hours shooting, shade breaks are needed which is where the necessity of a shade structure comes in, where the officers can relax, clean guns, take a lunch break or whatever they may need. The construction of the project was only part of the whole timeline and what needed to be done, as one knows preconstruction regularly needs a large allotment of time to be performed thoroughly. Lots of planning and preparation was required to perform this project efficiently and to make sure standard means and methods were used, but there were also different things that needed to be done to ensure the shade structure was going to hold up and be completed efficiently.

Key Words: Construction, Pergola, Wind Loads, Shear Loading, Framing

Introduction

This project was brought to my group's attention by Cal Poly SLO professor Daniel Knight. The project was for the Paso Robles Police Department out at their shooting range just off of Highway 46 near the Paso Robles Municipal Airport. Groups of Cal Poly students have done projects out at their shooting range in years past, starting with grading and earthwork to build a level area with a bank to catch all the rounds that are fired off. After that another group came in and provided reinforced concrete walkways filled with decomposed granite to give the officers a steady and safe multiuse surface. Fast forward to Fall of 2021, the Police Department reached out to Daniel Knight yet again to get more work done, this time in the form of a shade structure between two sea trains that were already on site. Paso Robles tends to get very warm, especially in the Summer months, making training in the direct heat an unpleasant experience. With that, they recruited to Daniel to see if anyone had any interest in building a shade structure up at the shooting range. Daniel pushed out a

mass email to many of the students in the Construction Management Department asking if anyone wanted to form a group and tackle this project, with him being the SME (Subject Matter Expert), which makes sense as he has had years of experience with this type of work, and had been the Subject Matter Expert for the previous projects in conjunction with the Police Department as well. That is where I and some of my peers, Evan Cogswell and Kevin Jagggers, formed a group and said we would be interested in performing this project, we were awarded the project and got started on our proposal right away.

Process and Lessons Learned

The first step in the process was to get the project approved and assign scopes, though this project is plenty large for 3 people to have sufficient work, we still felt it beneficial to break in to multiple scopes. The larger scope that Kevin Jagggers and I tackled in the design stage was the main structure, including the framing and the roof itself. Evan Cogswell decided to tackle the back wall that served as both a windbreak and a shear wall. With that in mind, we went to work on separate proposals, answering the whys, and how it is actually going to be a feasible project.

The next step was coming up with a design to send to the police department to approve so we could get started on a budget for them. After lots of discussion in the Fall and over Winter break, within a few weeks of the quarter starting, we were able to come up with a couple of designs using span charts, wind load calculations, and using the Simpson Strong Tie website to find the right materials for our needs. We sent the designs we came up with to the commander of the Police Department, Caleb Davis, and he told us to pick something that we wanted to do and felt comfortable doing, essentially the entire design was in our hands. Our original designs were having the roof be built on top of the sea train boxes, spanning roughly twenty feet, but that was going to take more earthwork to get the boxes level with each other, so we opted against that and decided upon a freestanding structure, which involved collaboration with Evan and his wall design to create a structure that was going to be tied together, which will help the strength and longevity of this structure. We sent in the final design with a detailed budget, got it approved by Daniel and the Police Department, and we were awarded \$4,000 to complete this project.

The following step was material procurement, during this time, since the start of COVID-19, materials have been significantly more expensive, namely dimensional lumber, so we had to shop around for quite some time to get the best deals on lumber. The roofing material was another item that had a long lead time, it was roughly one month from the time of ordering to the delivery date, though it did end up coming approximately one week sooner than anticipated. For the pressure treated lumber, the 6x6 rough cut post that went in to the ground, we purchased from Big Creek Lumber in Atascadero, as they had the best prices and the location was convenient. Evan also ended up purchasing redwood slats and 4x4 pressure treated posts from Big Creek Lumber. The 2x10x20' joists were purchased from the Home Depot in San Luis Obispo, and we were able to transport all of our lumber materials to the jobsite our selves, courtesy of the Cal Poly Logging Team utility trailer, saving us hundreds in delivery fees which helped us stay within our allotted budget. The rest of the materials, namely fasteners and concrete mix all came from Lowes and Home Depot between San Luis Obispo and the jobsite, based off of availability and proximity.

At this point, with materials procured, it was time to break ground on the shade structure. We performed the layout of where the posts were going to be located, and began drilling with a 2-man auger that had been rented for us. These were all new experiences for the group, so lots of back and

forth discussion happened, which seemed to be a useful trend in the construction of the project. We based the layout off of the edge of the concrete walkway, as that was the only current permanent improvement on site, the sea trains were not level nor were they square with the concrete. Fortunately, we caught this early in the layout process, otherwise it would have created issues for us down the line. We measured back from the concrete to get the front posts to the same distance, set stakes with stringlines attached, and used the Pythagorean theorem to create the shape we wanted for the spacing of the columns. This process took much longer than anticipated, but it came out square and was a great learning process for us. We then removed the string lines and drilled the holes with the auger where the columns were going to be set, hitting bedrock at roughly the same depth in all eight holes. We kept the layout stakes where we had tied the stringline to, allowing us to have our consistent reference points throughout the whole layout, drilling, and column setting process. Acquiring the lumber, performing the layout, and drilling the holes concluded the first weekend of work.

The following weekend it was now time for the long and tedious process of setting the columns. We purchased a few hundred dollars of concrete mix, and water tanks had been installed on top of one of the sea trains, allowing us to have all the materials we needed to mix many wheelbarrows of concrete to fill the holes. We left all of the columns at the height we purchased them at as the elevations of each hole was slightly different, allowing us to trim after they had been set. Fortunately, the three of us were working in conjunction on the actual construction, being that a majority of the tasks we had to perform could not have been done with two people. We lifted the columns in to place in the holes with the string lines set up, allowing us to square the columns before concrete was placed in the hole, and braces were built off of the columns so that they could be adjusted to level. While placing and mixing concrete, we checked the level periodically to ensure nothing had moved during installation, and adjusted accordingly. Setting the posts, mixing and pouring concrete, and making sure everything remained square and level was both a time and labor-intensive process, which ultimately took another full weekend.

We then were able to start framing, which began with cutting the posts to the correct slope and height using benchmark measurements and stringlines. We then began building 4x10 beams out of 2x10 boards, as the cost for a 20' 4x10 was exponentially higher, we set screws to hold it together then nailed them together. Lifting them on to the posts was a task in itself, as was drilling the holes for the mounts. The holes would have been easy if everything was straight, but during the week the columns had warped a considerable amount, making it nearly impossible to drill a hole straight from one side of the column or beam to the other. Fortunately, there was enough adjustability within the mounting brackets to make it work. We then trimmed the ends of the beams off giving us our final dimensions, which allowed us to perform layout and spacing on the beams for the joist hangers. We hung the joists in an unconventional manner as the twenty-foot joists are hard to handle and nearly impossible to hang within our workspace, so we put up the hangers first then cut and hung each joist, rather than hanging joists then fastening the hangers.

Once the framing was done, we were able to install the roofing which was a long process when performing in a safe manner. What would have been the easiest is to tie off, then just work on the roof, but there were no harness spots, and though the OSHA regulation states its required, it would have not been logical, so we just opted to use ladders and work platforms, which took a considerable amount of time, but was the safest and readily available option. We then used metal specific roofing screws to secure the sheet metal directly to the joists. The last step for roofing was to apply a silicone sealant to the gaps between the rows of sheet metal to prevent moisture creeping up the gap.

When the roofing was finished we were able to complete the walls that Evan took lead on at the back end of the structure. There were 4 posts set in line with the rear of the structure that were then tied in to the roof on one of the end joists, adding much needed rigidity to the structure that was only increased when the walls were added, which served as not only wind and sun protection, but also shear walls. From there it was just making the asphalt neat, adding in some spots and removing drilling debris.

Curriculum Connection

This project used many different aspects of what I have learned both in classes, labor positions, and internships. With that said, much of it was also new learning, which is why our group was excited to be doing this one in the first place.

The first aspect, design, was one of the biggest hurdles we had to overcome, with not only having a complete design but also something that it structurally sound and built to spec with accounting for the areas wind and roof loads. The class series this most paralleled with was the ARCE (Architectural Engineering) courses. We learned about roof joist spans, shear loads due to wind loads, and cantilevered loads. All of which we had to account for in the project, using things such as wind load tables, span tables, and finding which types of fasteners we would need to hold the roof down.

We then had to do buyout, which is not something we necessarily practice in our curriculum. This is something that I found to be difficult to get timely responses for from different suppliers, seeing that we were not a large construction company but rather DIY size, meaning we were not necessarily of high priority. Fortunately, most of the suppliers were helpful in helping us find what we need and recommending better materials to us. The experience of buyout is something that is regularly experienced by students participating in project engineer internships.

Finally, we had to do the construction which paralleled multiple classes, namely Surveying CM239, and Residential Construction Management CM214. The surveying coursework taught us the importance of layout and the best methods to use which was very helpful in the layout process for drilling the holes. Residential Construction Management was prevalent in the take off portion of the work, as getting materials and a price was one of the most important aspects of completing this project. It also has the actual framing and building of a tiny home aspect, in which we used many of the standard practices we used in our project, most notably roof framing.

Deliverable

The deliverable for this was something that the Paso Robles Police Department specifically requested, though the design was left up to us, the students. The final deliverable was a free-standing shade structure, bordered by two sea trains, and a shear wall at the rear of the structure. It sits with a roof height of 8.5' and 9', dependent on the slope of the ground it was built on and slope of the roof to accommodate for water drainage. It is approximately 20'x20', with the columns set inboard of the ends of the structure, which allows some of the load to be cantilevered, taking stress off of the beams on the end. The end product is essentially to allow officers to train at their shooting range in all weather conditions, whether it is raining, windy, or hot out.







