

# **Paso Robles Police Department Shooting Range Shade Structure**

**Kevin Jagers**  
California Polytechnic University  
San Luis Obispo, CA

The Paso Robles Police Department uses a private shooting range about 15 minutes from their station and nearby the Paso Regional Airfield. This range is used for training and certifications and the California Highway Patrol and other local law enforcement organizations have access to do the same. The Paso Police department received a grant from the state to make improvements to the range and they have decided to allow Cal Poly students to use much of the grant to complete senior projects at the range. With the climate in Paso Robles being quite hot, with summer temperatures frequently in the ninety-degree range and even reaching the hundreds, a shade structure became a priority for the Department. While construction of the project was a major undertaking, design and planning were very significant parts of the project. With the strong winds that can occur in Paso Robles, it was important to ensure the structure would hold up to the loads that it would experience. Additionally, with long material lead times, it was important to finalize the design early so that the proper materials could be ordered to complete the project safely and efficiently.

**Key Words:** Construction, Layout, Framing, Shear, Windbreak

## **Introduction**

In past years groups have completed projects such as: Regrading and building up the embankment behind the targets to increase safety, placing a reinforced concrete walkway with shooting positions at five, ten, twenty-five, and fifty yards surrounded by a decomposed granite base. With these major improvements to safety and functionality completed, the Paso Robles Police Department looked to improve the comfort of the range to extend training hours. The shade structure fulfilled this goal by providing an area where officers can get out of the sun when preparing and cleaning weapons on hot days, it would be built between two existing shipping containers used as storage to create a semi-enclosed area. The Paso Robles Police department notified California Polytechnic professor Daniel Knight, who has served as their contact for multiple senior projects, who introduced this project to the Cal Poly CM department, my group and I jumped at the opportunity. He also served as our group's Subject Matter Expert which made sense because he has years of experience in the industry and has

overseen projects at this site before. I formed a group with some of my classmates, Parker Smith and Evan Cogswell, and we applied to complete the project. Our group was selected to complete the project and we began meeting with Commander Davis of the Paso Robles Police Department to ascertain the qualities they were looking for and started work on our proposal.

## **Process**

The process began with determining the requirements for the design that the Paso Robles Police Department desired. We met with Commander Davis once over zoom to get a general idea of what he was looking for and exchange contact information, we came up with some initial design ideas and followed up with a site visit to assess the feasibility of each of our design ideas. Once we had an idea of the direction we were going to move in we began breaking down the scopes of work so that we could more efficiently work on the design. We decided that Parker and I would take on the framing and roofing of the main structure, and Evan Cogswell would take on the windbreak and shear wall at the rear of the structure.

Once we had decided on the scopes that we would be working on we began work on our final design. We took the Departments wishes into consideration to create an idea of the rough size and look of the structure. We used span tables and calculated wind loads to size the members of the structure and prepared multiple different framing designs to compare costs. The Simpson-Strong Tie website was also very helpful in determining the hardware and connections that we would need. Once we prepared three designs, we began weighing the pros and cons of each. Two of the designs had a width of 24' feet. In the first 24' design we framed it using dimensional lumber, however, this design would have required a support beam in the middle which would require columns in the middle of the space which was not preferred by the client. The second 24' design used trusses tied into the shipping containers on-site. Unfortunately, the shipping containers were not level, and it would be too costly to regrade and level the containers or create a structure for the trusses to sit on. The design that made the most sense was a free-standing 20'x20' structure with a windbreak/shear wall in the rear. This design was approved and awarded \$4,000 as a budget to complete the project.

A significant part of the process was material procurement. At the time of this project, lumber prices had come down slightly from their peak but were still quite high. For this reason, we were sure to request quotes from multiple suppliers and were very surprised at the level of difference in price between different suppliers. For this reason, we decided to get the pressure-treated timbers and redwood fence boards from Big Creek Lumber in Atascadero and the 2"x10"x20' lumber from Home Depot to obtain the best price. We were able to borrow a trailer from a club at Cal Poly and were able to save on delivery fees. The roofing, fasteners, and concrete were all purchased from Home Depot and Lowes. The roofing had the most significant lead time; however, this was not much of a concern as placing the roofing was one of the last activities to be completed so the lead time would not hold up the construction process.

At this point, it was time to begin construction. We began the layout and decided to square the structure with the concrete walkway as the containers were not only not level but also not square to each other. Once we measured from the front of the concrete walkway, we used the Pythagorean theorem to find the other two corners. From there we placed stakes in line with the edges to place string lines and marked the hole locations. Using a rented auger, we dug the column holes and put the string lines back up. The next weekend we returned to begin setting the columns. This process took far longer than expected, however, one by one we were able to set the columns and brace them so that they remained plumb. We returned the next day to place the concrete in the holes. We pour the holes

one and a time and checked that the columns were still plumb after each wheelbarrow load of concrete was mixed and placed ensuring to rod the concrete as it was placed to remove voids.

Now that the columns were set, it was time to begin framing. The first step was to cut the four main columns to the proper height and angle to provide roughly a 1/3:12 roof slope to provide adequate drainage. The next step was to build and place the beams, we built two-ply beams out of the 2"x10"x20' lumber and drilled holes in the columns for the t-straps that would secure the beams to the columns. It was necessary to drill these holes before lifting the beams because the beams would need to be braced once lifted for safety purposes. The beams took all three members of our group to lift safely but we were able to place both beams safely. The issue came when we began drilling the holes in the beams for the t-straps, we found that one of the columns had developed a significant twist as it lost some moisture in the heat. This made it very difficult to line up all four holes on the upper portion of the t-strap but we were able to work through the problem with persistence. Now that the beams were secured, we were able to cut the beams to their final length and begin laying out the joist hangers. This was a relatively quick process as we just had to mark the locations for and place the hangers, cut the joists to their final length, then lift them one by one and secure them. Once all the joists were hung, we placed the rim joists and tied the back one into the shear wall columns.

Once the structure was completely framed the last thing to complete was the roofing. To remain safe while roofing we decided to use work platforms and ladders as opposed to being on top of the roof. While it would have been quicker to work on top of the roof, we did not have the necessary equipment to tie-off and did not have space in the budget to purchase multiple harnesses and leads, as well as hardware to create tie-downs for the leads. Once we finished the roofing Evan began work on the wall in the back, once the boards were placed the back wall served as a shear wall and added a significant amount of rigidity to the structure. At this point, all that was left to do was clean the job site and leave it looking better than when we began construction.

## **Lessons Learned**

Many of the processes in the construction of this project were new experiences for everybody in the group. Early in the project during the design phase, I learned several valuable lessons, the first being the importance of completing a site visit before getting too far into a design. I was glad that we scheduled our site visit so early because we found out that a number of the ideas we had simply were not feasible so we did not have to waste much time creating designs that would not be able to work. On that note we also learned the importance of balancing cost and benefit with the client, while it would have been nice to make the structure slightly wider, it simply was not worth the cost that it would incur as there were many other projects the Department wished to complete and only so much grant money. I also enjoyed the amount of experience I got using span tables and wind loading software when sizing the members.

Most lessons learned came from the actual construction of the project. While I have taken part in and been around a lot of construction in my life, I have not had the experience of completing an entire project from start to finish without a significant amount of guidance from a more experienced person. The first thing that I had not realized was how difficult the layout would be given how out of square the containers were, once we decided to square the structure with the concrete walkway the process became much simpler. I also did not anticipate how difficult it would be to set the six-by-six columns. Due to the weight of these columns adjusting them to the proper position and completely plumb was a task in itself, though once the base was in roughly the right position it was not too difficult to brace

them. The last part of the construction that we found particularly difficult to complete was the setting of the beams, as mentioned in the process section, one of the columns developed a pretty significant twist once it dried out more after being placed. It would have likely been much easier to drill the holes for the t-straps on the ground and use a more temporary bracing once the beams had been lifted before connecting them to the columns.

### **Curriculum Connection**

This project utilized several skills that I have learned through Construction Management classes at Cal Poly and previous internships. While this project covered several things that I have been taught about it was exciting to be practicing the skills firsthand.

The first class I will discuss is CM 239, Construction Surveying, and CM 214, Residential Construction Management. These two classes, among other things, covered several aspects of layout. However, some of the most significant curriculum connections came from the ARCE classes. While I do not see myself doing a significant amount of design in the future, the lessons learned in ARCE in effectively sizing framing methods were very useful in the design phase of this project.

### **Deliverables**

The deliverable of this project is shown in the pictures below. We were tasked with creating a shade structure for the Paso Robles Police Department at their shooting range to make training sessions more tolerable during the hotter months. We used the space between the two existing shipping containers, between these containers and the wall built in the back of the structure, it provides shade at virtually all hours of the day. Additionally, given that these containers are used as storage, it made the space a good area for setup as well as instruction on cleaning and maintaining weapons. The completed shade structure covers a roughly 20'x20' area and is roughly 8.5' tall and constructed out of 6"x6" pressure-treated timbers and 2"x10" Douglas Fir lumber. The rear wall was constructed out of pressure-treated 4"x4" and rough cut 1"x12" redwood. Other than the project completed we also were sure to keep track of all our purchases to create a running budget which was submitted at the end of the project.







