Kentucky St. Fence: 3D Model, Price Estimate, & Construction

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This project consists of the design, estimate, and rebuild of a residential fence. The house is located on Kentucky street in San Luis Obispo, California. The project was completed by two Cal Poly Construction Management students, Andrew Shafer and Michael Cerone, during the spring quarter of the 2020 academic school year. These students will be referred to as “the builders” throughout this paper. The beneficiary of the fence was a local San Luis Obispo woman, who lives on the same street as Michael. Michael walked past the beneficiary’s house every morning, and noticed that the backyard fence was in poor condition and needed replacing. The beneficiary was thrilled, and mentioned she had been wanting to replace the fence for years. The builders learned valuable lessons and overcame obstacles during the course of this project. Such as a global pandemic and a shelter in place order, which made face to face communication with the beneficiary more difficult, as she was an elderly woman. This project involved the creation of various fence designs, the creation of a cost estimate using excel spreadsheets, the demolition of an existing fence, the construction of a new fence, and landscaping around the finished fence.

Key Words: Fence, Residential, Rebuild, Backyard, Construction

Introduction

This project first arose from a desire to physically build something and leave a mark on the San Luis Obispo community that will last generations. This sounded much more appealing than writing a research paper that will most likely not have any lasting impact. Getting to help improve the life of a member of the community was something very rewarding about this project. Another intriguing aspect of this project based project was gaining first-hand building experience in residential construction. The beneficiary of the project was an elderly local San Luis Obispo resident named Donna Nash, who has lived in the community around Cal Poly for over 30 years. Donna was found by fellow project member Michael Cerone, as Donna lived on the same street as Michael. Michael would walk past the beneficiary’s house each morning, and noticed that the backyard fence was in very poor condition. Donna was frequently gardening in the front yard, and Michael decided to ask if it would
be okay to have the fence rebuilt by 2 Cal Poly ConstructionManagement students as part of asenior project. Donna was ecstatic, and couldn’t wait for the project to get started. This seemed to be an excellent project based project, as it would directly benefit someone in the San Luis Obispo community, and provide a test of the building knowledge and abilities obtained from a degree in Construction Management at Cal Poly. After conversing with senior project director Phil Barlow, it was determined how the project could provide different deliverables for each group member. It was decided that the pre-con, which consisted of an estimate and the 3D fence models, could be split up between the group members. While the construction of the fence would be a group effort. It was agreed that this was an acceptable scope of work for a two person project, and the project was approved. For the purposes of this paper, the students, Andrew Shafer and Michael Cerone will be referred to as “Builder A” and “Builder B”.

**Pre-Construction Activities**

*3D Modeling*

The first step the builders took after the project was approved was collaborating with subject matter expert Eric Brinkman on possible variations in fence designs that could be used. After conversing with Brinkman, it was agreed upon that both of the builders create different fence designs and have the beneficiary pick between them. The builders created the designs using the 3D modeling software ArchiCAD, which was provided by the university. The models can be seen below in figures 1a and 1b. Builder A created a model that closely resembled the beneficiary’s existing fence. Which consisted of six feet tall, five and a half inch rounded top pickets and three rails that faced inward toward the backyard. Builder B created a model which consisted of six feet tall, five and half inch pickets with a pointed top rather than a rounded top. After seeing both models, the beneficiary decided to revise both of the builders models and change the pickets to have a flat top, which mimics the existing fence.

![Figure 1a. Builder A fence model viewed from street](image-url)
Estimate

Builder A was tasked with creating an estimate for the price of materials for the project. The first step in the estimate was determining the amount of material that would be needed for the project by taking measurements of the beneficiary’s backyard. The three measurements that were needed were the length parallel with the street, the length of the existing gate, and the length of the side perpendicular to the street. After obtaining these measurements, the builders needed to determine the materials that would need to be purchased. The beneficiary wanted the new fence to mimic the existing fence, which made determining what was needed relatively simple. The existing end posts were in great condition still, and were quite sturdy, so those were to be kept. This left the two interior posts to be replaced. There were to be three rails connecting each post, and one additional rail stacked horizontally across the top of each post. The number of pickets were estimated by dividing the total measured length by the width of the pickets. The other items that were included in the estimate were primer, paint, and mulch for the landscaping. Builder A determined the price of these items by referencing the Home Depot website, since this is where they would be purchased. The project total came in just under $1000.
Securing Funding

The next step in the pre-construction phase was securing funding for the project. Builder B fortunately was family friends with an employee of Lab Design, which is a successful lab equipment installation company in the San Francisco Bay Area, and they agreed to fund our project. The owners of Lab Design have 2 kids who attended Cal Poly. Once a source of funding was secured, the construction phase of the project was finally ready to begin.

Survey of Property Lines

Another idea that subject matter expert Eric Brinkman suggested that the builders do is complete a survey of the beneficiary’s property lines. This was to ensure that the fence is built within the property line. To the luck of the builders, the beneficiary had recently had her property lines surveyed, and was able to provide the builders with a copy of the survey. After reviewing the survey, the builders were able to conclude that her existing fence was on her property line, and the same footprint could be used when constructing the new fence.

Construction Activities

Demo of Existing Fence

The first stage of construction was demolishing the existing fence. The original fence can be seen below in figure 2. The builders had to take precautionary measures to make sure that the beneficiary’s garden adjacent to the fence was not damaged in any way. It was agreed that the builders could not simply use sledgehammers to destroy the fence, this would be too messy and have too great of a
potential of damaging the garden. The fence needed to be taken apart one piece at a time. The existing pickets were fastened with screws, so the builders began by removing each screw from the pickets with a drill. The majority of the pickets came off relatively easily, however, some of them unfortunately had very stripped screws or rusted screws from being over 30 years old. These pickets had to pulled off using a crowbar. The rails were removed with ease, they were secured by 4 toe-screws. The gate frame had to be removed next, which was relatively simple. A monkey wrench and a screw driver were the only tools necessary for removal. The part which gave the builders the most trouble during demo was the removal of the existing posts. The builders used shovels to dig around the piers until they were loose enough to be tipped over and pulled out of the ground. The old material needed to be removed from the site, so builder A loaded it in his truck and brought it to his property until it could be taken to the dump at a later date.

![Image](image.png)

Figure 3. Beneficiary’s original fence falling over.

**Piers/Posts**

Before any pouring of concrete could be done, the builders needed to find a way to ensure that these new posts would be perfectly inline and level. A string, seen in figure 3b, was pulled from the top of one of the remaining posts to the top of the other, and tied to a nail. This string would make it much easier to determine if the new posts were inline and level when they were being installed. Once the existing posts were removed, the builders shaped new holes for the piers that needed to be poured. This was difficult, as whoever poured the previous piers did not do a fantastic job, and the holes were not exactly in line with each other. The builders had to backfill a portion of the existing hole and enlarge the opposite side of the hole in order to make the two post holes even. This can be seen in figure 3a below. The builders then prepared a concrete batch using premixed ninety pound bags from The Home Depot. Before pouring any concrete, three inches of gravel was added to the bottom of
each of the holes to help with drainage. Once the concrete was to the builder’s liking, it was poured into the newly dug holes and around the base of the post. The builders switched off between pouring the concrete and holding the posts, and finished off by prodding the concrete with a piece of rebar to remove any air pockets. The concrete was left to harden for the next few days, and when the builders returned the posts were in great position.

Figure 4a. Builder B prepares to pour concrete into post hole
The builders needed to connect the fence posts with three rails, one on the top, middle, and bottom. There would also be a second top rail that ran across the tops of the posts, giving the top of the fence a clean look. The boards used for these were 2x4 Douglas Fir, that were cut to the appropriate length between each post using builder A’s circular saw. Something that caused the builders issues was the fact that wood shrinks when it loses moisture. This was not taken into account when the 2x4 rails were cut to a precise length in order to fit perfectly between the posts. The builders came back the next day to install the rails and discovered that the wood has gotten smaller and some of the boards were no longer the perfect length. The builders made sure to buy wood was that more dry and cut it correctly the second time. Starting with the top rails, the builders secured the rails to the posts by toe-screwing four screws, one on the top and bottom of each end of the board. The builders used a level to ensure that the rails were installed correctly. This process was repeated for the middle and bottom rails. The toe-screws on the bottom side of the bottom rail were difficult to install, as the fence was on a slope, and the bottom of the fence became very close to the ground. Getting the rails installed was a big milestone for the builders, as the fence was getting closer to a final product. Before installing the pickets, the rails and posts were primed and painted, in order to ensure that the fence got maximum paint coverage and protection.

**Pickets**

The pickets that the beneficiary requested were six feet tall, five and half inch flat top pickets. The pickets were secured to the rails with six total screws each. Two into the top rail, two into the middle rail, and 2 into the bottom rail. It is important to firmly secure the pickets to prevent warping of the wood over time. Since the fence was built on a slope, the could not remain six feet along the entire fence. In order to the keep the top of the pickets at the same level, the builders had to measure the difference in height between pickets and cut the difference off of the bottom of the picket. The length
of the fence was not perfectly dividable by five and a half inches, so two of the pickets, one of the side parallel with the street and one on the shorter perpendicular side, would have to be trimmed lengthwise to fit. The builders needed a table saw to perform this operation, which builder A was able to provide. The builders decided that it would be a good idea to apply 2 coats of primer and paint to the pickets before they were installed. This was to ensure maximum coverage and protection, as was done with the rails. Installation of the pickets was another huge milestone for the builders, the fence was nearly completed. The only remaining pickets were those that would be attached to the gate frame, which was yet to be installed.

![Fence rails installed and pickets drying after being painted.](image)

**Gate**

After the pickets were installed, the builders could begin installing the gate frame. Originally the builders planned on using a sliding gate system, however, after further discussion with the beneficiary, it was determined that a traditional hinged gate was preferred. The gate the builders used was a black steel frame hinged gate that was secured to the adjacent post. The beneficiary made it clear that the ability to easily move the trash bins from behind the fence was very important. The builders made sure to meet this demand, and the newly installed gate allowed the beneficiary to easily move the trash bins. Within the metal gate frame, there were three 2x4 boards, these were primed and painted at the same time the pickets were. The pickets were attached in the same manner that they
were attached to the main stretch of fence. The builders ran into the same sizing issue with the gate as they did with the main stretch of fence. The end board needed to be cut length wise in order to be slim enough to fit perfectly. The beneficiary requested that a sturdy latch and lock be added to the new gate, so the builders purchased a latch and lock set that was substantially larger than what was on the previous gate.

**Landscaping**

One of the last tasks that the builders did was help bring the beneficiary’s garden to life. The first step was cleaning out any debris that had fallen into the soil during construction. These included broken pieces of wood, aggregate from the concrete mix, and dropped screws. The builders then weeded around the plants and poured fresh mulch on top of the soil. The builders wanted to match the color of the new mulch with the rest of the beneficiary’s garden. The beneficiary was very happy that this landscaping was done, and mentioned how perfectly it matched the rest of the garden. With almost everything completed, the only thing left to was clean up.

**Power Washing and Final Clean Up**

The builders had unfortunately let a few drops of paint fall onto the beneficiary’s patio on the inside of the fence. Builder B was able to solve this issue, as he happened to own a power washer. The power washer removed the paint drops with ease and the builders didn’t stop there. The power washer worked so well that the builders decided to clean the entire patio and shed that were adjacent to the fence. The end result was an exceptionally clean surface that the beneficiary was ecstatic about. The builders had also gotten a few drops of paint onto one of the hinges of the gate frame, and needed to remove it. The solution was paint thinner, which removed the fresh paint from the hinge plate without any issue. An image of the completed fence can be seen below in figure 6.

Figure 6. Final Completed Fence
Project Issues and Lessons Learned

A Global Pandemic

In March of 2020, Covid-19 forced California to enter a state wide shelter in place, which caused a serious delay in the project. Before the builders could continue work, it was agreed that both of them would do two weeks of quarantine. Once the shelter in place started, the builders could no longer interact with the beneficiary as much in person, for both of their safeties. This took away an emotional aspect to the project that was greatly appreciated by the builders. One of the most rewarding parts of the project for the builders was getting to collaborate with the beneficiary every workday.

Wood As a Building Material

Wood has many flaws as a building material, and the builders ran into all of them during this project. Many of the boards, both the 2x4’s and pickets, were naturally bowed, which caused issues. Some of the bows were miniscule enough that the builders could still use the boards. However, on multiple occasions the bow in the boards were so bad that it simply could not be used. This became wasted material and caused the builders to have to purchase more. The worst bow came when the pickets were cut lengthwise to fit perfectly. Immediately after the board was cut it became bowed. This is due to the fact that the width of the board was keeping itself from bowing, and when the tension was removed it gave in. Another issue with wood is that it holds moisture, and expands when it does so. This became an issue when making precise cuts, as the boards were cut to fit perfectly between two posts. Once the wood dried and the moisture left the wood, the wood shrank, which would cause the boards to no longer be long enough. The lesson the builders learned from this was to always let wood dry completely before making any cuts, as it would have saved them plenty of time and materials.

Buying Everything We Need at the Same Time

Wasting time by taking too many trips to The Home Depot was another issue the builders had during this project. On multiple occasions the builders would only purchase items that they planned on using for that day. What the builders should have done was make one large purchase of all the materials that were needed in one trip. If both of the builders loaded up their trucks then this certainly would have been possible. The only issue this would have caused is finding a place to store the materials before they were ready to be installed, but this would not have been hard to solve. Both builders lived very close to the beneficiary and had backyards to store the excess material in. Doing this would have saved many unnecessary trips to and from The Home Depot.