Wooden Bridge Demolition and Reconstruction

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The Conejo Recreation and Park District (CRPD) is a nonprofit city government organization that maintains the parks and hiking trails in Thousand Oaks, California. They were informed that one of the bridges at the Stagecoach Inn, a landmark park located in Thousand Oaks California, was old and sagging in a way that made interfered with the flow of the creek it spanned over. A plan to demolish the current bridge was created. Utilizing ArchiCAD and Microsoft Excel a design and an estimate were developed for a new bridge that would be built in its place. This bridge would be tall enough to allow for ample room for the creek to flow beneath it. During the Winter of 2019, a team of volunteers and two CRPD Rangers demolished the old bridge, cleared and grubbed the area to allow for more water to pass underneath the new bridge, and prepared the site for the construction of the new bridge. The following day materials were procured to construct the new bridge and the bridge was constructed and erected behind the Stagecoach Inn. This paper reviews the process of bridge replacement, including the design, the demolition, and the construction.

Key Words: Bridge, Demolition, Construction, Design, Planning

Introduction

In the City of Thousand Oaks, California, the Conejo Recreation and Park District (CRPD) oversees monitoring and maintaining the local parks and hiking trails in the area. These parks and hiking trails are typically used for leisure activities like walking and jogging, and occasionally field sports such as soccer and basketball, so the parks and trails are properly kept by CRPD to ensure maximum public satisfaction. (Conejo Recreation and Park District, 2020). However, occasionally, a larger scale construction type project will come up at one of the parks or trails like the need for some new benches or the reconstruction of park of hiking trail. If there is no urgency for the project to be completed, CRPD will often put it aside for volunteers who may need to complete the project to fulfill some volunteer or citizenship requirement. An example of this is the Boy Scouts who require that every Scout must lead and complete a service project in the area to become an Eagle Scout. This project is known as an Eagle Scout project and the scope of the volunteer projects that CRPD sets aside are perfect for them and many other service style projects. The project that this paper will discuss is the destruction of a bridge and the design and reconstruction of a new one to take its place.

The purpose of this paper is to provide a full description of a bridge replacement project including:
- The design for a new bridge
- The estimate used to procure materials for the new bridge
- The process of the demolishing the old bridge
- The process of constructing the new bridge
Project Background

The site for the project was located behind the Stagecoach Inn in Thousand Oaks, CA. The Stagecoach Inn used to be a popular resting spot for travelers heading from Los Angeles to Santa Barbara. Today it is a historical museum where anyone can come and see historical artifacts that tell about the history of Thousand Oaks and the Conejo Valley (Stagecoach Inn Museum, n.d.). Behind the Stagecoach Inn is a small hiking area where there are many bridges that are used to help hikers pass over small streams in the area without disturbing the stream. The grounds keeper of the Inn reported to CRPD that one of the current bridges was old and had begun to sag in the middle creating little room for the stream to flow underneath it (Figure 1). In the winter during times of heavy rain it was noted that the water would even flow over the bridge.

CRPD wanted there to be ample room for the creek beneath the bridge to flow freely. To do this the current bridge needed to be demolished and the area beneath it needed to be widened and deepened so that the new bridge would create enough space for the water to flow below it. The new bridge would need to be constructed with materials that can withstand the conditions of the environment where the bridge is located. CRPD agreed to fully fund the project and provide necessary equipment when needed. No budget was set for this project, but CRPD wanted the project to remain as economical as possible.
Deliverables

The deliverables for the project were to create a design and estimate for the project as well as to complete the demolition of the former bridge and erect a new one. Each of these deliverables will be described in the sections below

Design

The bridge needed to span 13’ and needed to be 4’ wide. The material used to construct the bridge would need to be weather resistant. Other than this, CRPD did not mention any other design criteria. ArchiCAD, a design software, was used for the design of this project and a similar design was utilized rather than a more elaborate design so the new bridge would be easier to build. The design also closely resembled other bridges in the area which are basic in design but very functional. The design would utilize pressure treated wood since the bridge would be subjected to moisture and regular wood is susceptible to rot under these conditions. It utilized 4x6 bridge seats at both ends, 4x6 girders that would span the length of the gap, and 1x6 boards would be cut to be used as the steps. 3 pieces of rebar would be plunged through the bridge seats and the girders into the ground to hold the bridge in place. The design also included a guard rail on each side that would be constructed from 4x4 posts and 2x4 railings. The preliminary design created in ArchiCAD is provided in Figure 2.

Estimate

Once the design was finalized and approved by CRPD, an estimate was created using Microsoft Excel. The estimate was broken up into 4 main sections: (1) bridge body, (2) guardrails, (3) cross...
braces, and (4) rebar. This was done so that in case any one of these sections was not to be constructed, the cost for it would be easily removed from the total cost. Each section of the estimate except for the rebar section also included two subsections; wood/timber, and hardware so the two costs could be easily separated in the event that CRPD had extra timber or extra hardware left over from another project. The final cost for the bridge including all the sections was $395.92. An overview of the estimate is shown in Table 1.

<table>
<thead>
<tr>
<th>Section</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Body</td>
<td>$243.74</td>
</tr>
<tr>
<td>Guardrails</td>
<td>$86.41</td>
</tr>
<tr>
<td>Cross Braces</td>
<td>$26.33</td>
</tr>
<tr>
<td>Rebar</td>
<td>$11.82</td>
</tr>
<tr>
<td><strong>Subtotal:</strong></td>
<td><strong>$368.30</strong></td>
</tr>
<tr>
<td>Taxes (7.5%)</td>
<td>$27.62</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>$395.92</strong></td>
</tr>
</tbody>
</table>

Table 1. Table breakdown of the Estimate

*Demolition and Construction*

The final deliverables for this project were the demolition of the former bridge and the construction of a new one in its place. Both processes were completed in the winter of 2019. The process for both activities will be discussed more in depth in the following sections (See Figure 3 below).

Figure 3. Completed new bridge at the Stagecoach Inn
Site Preparation

In order to successfully demolish and remove the former bridge, a process was first developed to ensure the safest and most effective means of removal were being implored. The best way to remove the former bridge was to start by removing the guardrails and the guardrail posts from the main body of the bridge. Once that was accomplished, all the wooden deck pieces that made up the actual foot path for the bridge could be removed from the large girders. Once they had all been successfully removed from the body of the bridge, the girders could then be sawn into smaller pieces to make them easier and safer to lift. In addition to these precautions, a SWPPP plan was also created to ensure that foreign objects entering the stream below the bridge would be limited. All the old material was to be pill ed at a predetermined location near where the bridge was positioned where the grounds keeper would remove and dispose of it later.

The demolition and construction of the bridge was originally supposed to occur between Friday, December 27\textsuperscript{th} and Monday, December 30\textsuperscript{th} of 2019 but the schedule was pushed forward with the fear that it was going to be raining on those days. The actual bridge demolition occurred on Tuesday, December 17\textsuperscript{th} and Wednesday, December 18\textsuperscript{th} in the year 2019. (See Figure 4 below).

Due to the schedule change, there was reduced labor available. As per the demolition plan, the guardrails were the first thing to be removed. One by one the railings came off easily since the nails underneath them had rusted over time and had become very brittle and weak. The guardrails were all placed in the location as discussed by the grounds keeper for them to be disposed of later (See Figure 5 Below).
Once all the railings were removed the posts under the railings were removed next. Two of the posts were to be removed but the post that was closest to the stairs was to remain intact. In order to do this, some debris had to be cleared out first that was blocking visibility of where the post was fastened to the girder. One of the posts was also supported by a diagonal brace that would also need to be removed (See Figure 6 below).
Once both the posts were out of the ground and no longer attached to the bridge body, the wood deck boards were removed from the wooden girders. Once all the wooden deck boards had been removed from the girders, the girders themselves were removed. This was anticipated to be the hardest part of the removal process especially considering that there was only one person doing it. The chain saw that would be used to cut the large girders into smaller more manageable pieces had been requisitioned from one of the CRPD field offices. It took some time to cut all the girders down to manageable pieces and as soon as they were all cut down, it was time to attempt to move them. Even cut into smaller pieces, it was discovered that the girders were still too heavy to be moved by one person without the risk of serious injury so the rest of the demolition process would need to be postponed until the next day.
The next day CRPD requisitioned a team from the group known as the C.R.E.W which is a nonprofit youth employment organization that specializes in trail construction and trail maintenance to help with the remainder of the site preparation process (The Crew, (n.d.)). With their help the rest of the demolition and site preparation was done smoothly and completed in two hours (See Figure 7 below).

![Figure 7. Bridge site after removal of the old bridge](image)

**Construction Process**

As mentioned before, the construction process was abruptly moved at the last minute (See Figure 4 above). On December 18th, after the demolition and site preparation had finished and the site had been fully cleared and grubbed, material was procured from a local Lowes hardware store with the intent on beginning the construction of the bridge the next day. The actual cost for the materials for the construction of the bridge came in under budget at $379.59. The cost difference was predominantly due to the fact that CRPD had left over material that could be used for all of the girders of the bridge and we decided to only build one guardrail similar to the bridge that had previously been there that would utilize two posts instead of the original 3 from the design. We also decided to use deck screws to hold down the deck boards instead of nails based on what was observed with the nails from the previous bridge and based on best practice in general (Erdil, Y.). Once all the material was procured, it was determined that construction would commence the following morning.
Construction began on the morning of Thursday, December 19th of 2019. Due to the abruptness of the schedule change, many of the people who had volunteered to help with the project on the 27th through the 30th were unavailable on the day that the project commenced. The material was brought to the site in the back of the Ranger’s truck. It was determined beforehand that a small gravel area behind the Stagecoach Inn would be our layout area. There was an outlet on the back of the building where we were able to plug in the miter saw that was requisitioned from CRPD and we began cutting the 1” x 6” x 8’ pieces into the deck board pieces (See Figure 8 below). The 4” x 4” x 8’ pieces that were to be used as the bridge seat since we determined that 4” x 6” pieces were unnecessary were also cut in half by a chain saw.

![Figure 8. Miter saw and layout area](image)

Once all the pieces were cut to size, we began carrying them all to where the bridge would be constructed. Once this was done, we were ready to build the bridge body. We started by lining up the girders across the stream, so we know where they were going to rest once they were straight (See Figure 9 below).
Once we knew the location where they would rest, we used a gas-powered rebar driver to drive the 4’ pieces of rebar that would hold the bridge in place into the ground. We used the driver to drive the 4’ pieces of rebar through the 4x4 bridge seats (See Figure 10 below).
After all 6 pieces of rebar were drilled through the 4x4 bridge seats and into the ground we placed the girders on top. Once the bridge frame was in place, it was time to install all of the deck board pieces. This was done with two deck screws on each side. We utilized two impact drivers to do this and we used a large nail to create a small gap between each deck board piece so that they would not be butted up right next to each other (See Figure 11 below).
After all the deck boards had been installed, it was time for the final step which was constructing and erecting the guardrails. We took both posts and fastened them to the side of the bridge body with metal fasteners making sure to keep them at the same level. After the posts were in place, we were able to quickly install the wooden 2x4 guardrails.

**Project Analysis**

Overall, the project was very successful with regards to the budget and the schedule. The project came in under budget with a difference of $16.33. Even though the schedule had to be abruptly moved due to weather conditions, the project still finished ahead of schedule considering that the original projected schedule was 4 days in total and the actual project was finished in 3 days. As far as owner satisfaction goes, CRPD was very pleased with the newly constructed bridge and it has since done its job as a bridge in the hiking area. Since there has not been a rainy season yet since it was constructed it is difficult to say if the bridge is high enough and the creek bed is now wide enough to give the water enough room to flow. With that being said the gap between the bridge and the creek bed is a lot larger than previously so based on that alone it seems like it was a success in that area as well.

**Conclusion**

CRPD was informed by the groundskeeper of the Stagecoach in that one of the bridges was old and sagging to the point that it disrupted the flow of the creek. This project was set aside by CRPD in the event that someone needed to complete it for the purpose of fulfilling a service project style requirement since the undertaking of this project was not pressing and urgent. During the fall of 2019, a plan to demolish the current bridge, and a design and an estimate for the construction of a new bridge in its place were created. During the Winter of 2019, the current bridge was demolished, and the site was prepared for the new bridge to be constructed. The following day material was procured to construct the bridge and the bridge was successfully constructed. This paper outlined the process of the design, demolition, and construction of a bridge replacement project.

**Lessons Learned**

During this project, many different obstacles and unforeseen surprises came up that caused various different problems. Because of this one of the most prevalent lesson learned was to be prepared for any and hopefully all outcomes. If a plan A is fully worked out and ready to go you need to have a plan B as well full of plans and contingencies for what ifs that could cause serious delays if there is not a plan in place for them. Luckily on this project the only serious delay was the time it took to drive home to acquire a prybar that wasn’t on site but on a larger and more serious project this could be way more serious. Another lesson learned from this project was not to plan a project like this in the winter if you do not have an adequate plan for the event that there is a high chance of rain on the day you are planning to work. Because an adequate plan was not in place the project needed to be abruptly pushed forward and a lot of the volunteer workers were not able to make it to help out with the
project. Overall in the end even with the setbacks, this project went very well and smoothly and the bridge will be able to serve the community at The Stagecoach Inn.

Works Cited


