Roman Catholic Elementary Photovoltaic Project

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The use of photovoltaic panels in construction is rapidly growing all around the world. This paper summarizes the findings of a student-based project in Belize that was installed December 2016. The San Pedro Roman Catholic Primary School is the largest school on the island of Ambergris Caye, Belize with over 700 students in 22 classrooms ranging from Kindergarten to 8th grade. [1] Although the school has power supplied from the local electrical utility, power, outages occur frequently and the cost of electricity is considerable.

The project had several issues related to preparing the design, acquiring the materials and equipment, and developing schedule, shipping, and work planning. In this paper, I will cover specific topics of the project, including estimation, communications, and installation. I will discuss some of the problems I encountered that included a lack of communication, accessibility to the construction site, site layout, as well as the solutions I took to mitigate each problem. Finally, I will discuss my findings and the lessons I learned while working on this project.

Keywords: Photovoltaic, Installation, Estimation, Communication

Introduction

Project Description

For this project, I worked on a grant awarded by Electri International, The foundation for the National Electrical Contractors Association (NECA). Their Student Passport Initiative awards a NECA Student Chapter Team grant to meet a critical need to provide new or upgraded electrical service in an underprivileged domestic or international location of their choice [2]. The ELECTRI Student Passport Initiative awards up to $20,000, to a school that proposes the most qualified project proposal. The project proposed to ELECTRI focused on the San Pedro Roman Catholic Primary School in San Pedro, Belize. The installation included 14 photovoltaic panels, complete with an inverter, Automatic Transfer Switch (ATS), and all the terminations necessary to wire the photovoltaic system into the school's current electrical system. I dealt with the Belize government to procure customs forms, request quotes from vendors, and communicate with local personnel on the island to get technical questions answered.

Project Purpose

I chose this project because I believe the benefits of renewable energy projects have a positive impact for developing communities all around the world. This project gave me a sense of satisfaction and gratitude working with the people of Belize. I think solar power is an underutilized technology that needs to be applied in developing countries rather than developed ones. According to John Barton in his article *IP and Access to Clean Energy* 45% of the technology is produced by USA, China, Japan, and Europe. The focus should be on developing sources of power that eventually pays communities back in reduced energy bills which is the focus of ELECTRI's Student Passport project; "The goal of the Cal Poly Student Passport Initiative is to reduce dependence on the local electricity grid, encourage carbon neutrality, strive for net-zero consumption, build teamwork and better a community".

Key Factors

There are multiple contributing key factors that led to this project's completion. Some of these factors included huge lead times that greatly pushed-back the schedule. Because of these factors the quality of installation became at-risk. Key factors determined whether the project would be completed on time, under budget, and installed completely. The key factors I will focus on in this project will be communication, estimation, and installation. These factors influenced the project.

Communication

To install a complete system that satisfies the school's needs, proper communication between the locals on the island and myself. Delayed communication between the island and myself sometimes stalled for weeks, leaving unanswered questions open for long periods of time. To make crucial decisions, that should have been confirmed with the local electrician, Eddie Halliday, I had to make educated guesses on certain conditions of the site, how long materials would get through customs, and the best way to run conduit. This led to delays on scope of work for the installation and delayed shipping. Communications stalled because of cultural differences. It's much easier to get my answers answered locally in the states, where I know my peers will answer my questions as soon as possible. In Belize, the locals are on island time, which leads to a more relaxed mindset on the installation.

Estimation

Scope of work constantly fluctuated between the preconstruction trip to the day before installation. Part of the reason would refer to communication. Questions about the project were not getting answered fast enough. The assumptions I had to make changed the scope of work frequently and often. Some of the questions that I needed to answer that changed the scope of work includes how much power the administration building (To whom I are supplying power to), use on a monthly basis, where to mount 14 photovoltaic panels without risking security and safety, and what is the need for power at night? Using educated assumptions lead to a faulty scope of work that changed drastically during the first few days on site.

Installation

A big key factor that was addressed early in the project was who would install the entire system. Understanding all the components that goes into a photovoltaic system affected both the estimation and communication of the project. As a student team, learning how electricity works, and how the panels connect had a major learning curve to understand. Learning about the school's power supply was a big factor in determining how many panels to install, if battery backup was required, and what kind of wire to run to the subpanel. Putting the system in place took a lot of industry knowledge as well. And because the materials arrived on the third day of installation, the looming deadline of installation really took its toll on productivity.

Team Project Deliverables

Deliverable	Title	Description	Date	Location
1	Team Meetings	Logistics, Milestones, budget etc.	Wednesdays 2-3 PM	SLO, CA
2	Council Meeting	Proposed Project, awarded grant	July 2016	Napa, CA

3	Job Walk	Define scope, identify problems and conditions	July 2016	Belize
4	Full Estimation	Complete material and tool list	October 2016	SLO, CA
5	Ship materials and tools	Load and ship 2 containers to Belize	October 2016	SLO, CA
6	Duty Free Exemption Letter	Ensure the containers arrive, and clear customs duty free	November 2016	Belize
7	Material Arrives in Belize	Arrives, and clear customs	December 2016	Belize
8	Installation	Complete photovoltaic system	December 2016	Belize

Lessons Learned

Communication

The biggest drawback with a construction project in another country is the amount of communication from parties both in the USA, and in Belize, to complete a successful project. Overseeing communication means a lot of people are looking to you to answer questions by from the opposite party. Because there was a finite amount of time to prepare for installation, getting questions answered quickly from the island was vital. Sometimes it would take a couple of weeks to get a response from local sources. Looking back, it would have been more intuitive to set up a weekly project meeting via Zoom or Skype, where all of the important personnel are required to attend in order to stop the build up of unanswered questions over long periods of time. Eventually I ended up making phone calls daily to answer questions and to track shipping which was not a good use of my time.

Installation

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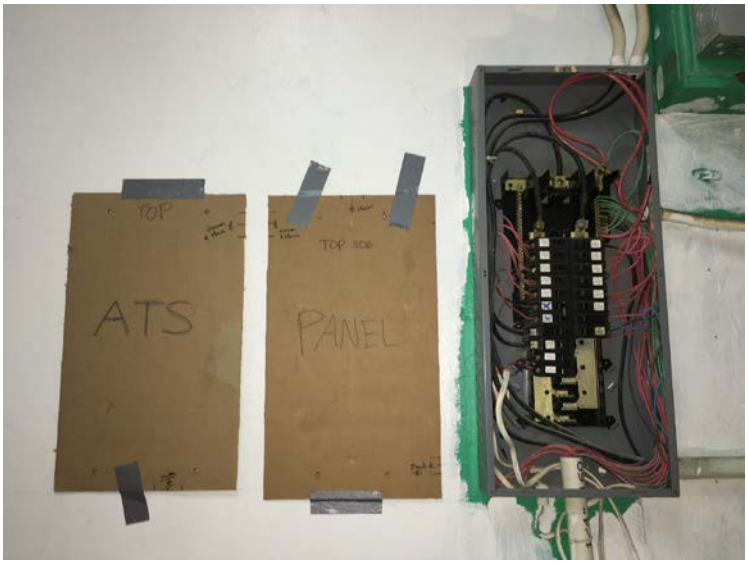
Not only did I have to see over the entirety of estimation, but understanding how to install the system was also required on this project. Because the materials did not arrive on site until day three of installation, there was a lot of down time. Instead of sitting around for two days and going site-seeing, the free time was spent pre-planning our methods of construction. Routes for conduit were pre-dug in the sand that lead to the electrical room where we were to install the sub panel. The sub panel, ATS, Inverter, and sub panel locations were laid out on paper. Teams formed, splitting up the workload in three different parts; mounting photovoltaics, pulling wire, and mounting gear. The constant heat slowed down installation. Eventually, installation started earlier in the day to account for the heat. Looking back, I think it was a benefit to have a delay of installation because it led to a lot more fundamental planning and an easier installation.



Our layout of the ATS and subpanel. This item took a few days to completely lay out to get the correct width and heights of spacing in between each item.

Because of the siting water, we wanted to make sure to clear out any items or liquid that was on the deck when we arrived. It took about a day to remove excess materials from the jobsite.

Conclusion

This project became much more than just a student based photovoltaic project or my senior project. Working with professionals in the United States and out has taught me how to learn and understand how the construction industry works. The new knowledge I have learned prepared me for working in the real world. Understanding your customer's needs, and how they operate became the biggest lessoned learned. Not only did I have to adapt my communications to suit my customer, constantly following up and keeping RCE in the loop persistently meant a more completed project. By estimating this project, I learned that there are a lot of small components that need to be factored into any project. Every piece needs to be looked over, and made sure that it is compatible with a complete system. Industry leaders can give you a better understanding of what components you need to build a system. As a project manager, I need to convey my customer's needs with my vendors to produce a correct and complete project. Understanding that an inverter without battery backup is needed for the system became a huge problem. Not only did the complete system not get installed when I went to Belize, ordering the correct whips and batteries for the inverter meant another couple of months of coordination and figuring out who and how to pay for the extra materials. Overall, this project has taught me a lot of important lessons in construction. These lessons and skills will follow me throughout both my professional life and my personal life.

Work Cited

[1]"Working with SPRC Primary, San Pedro, Belize's Largest Public School. "*Belize Kids*." Web. 21 Mar. 2017.

[2]Student Passport Program as of March 21, 2017. "*Student Passport Program", ELECTRI International.* Mar. 2017. Web March 21 Mar. 2017.