

Belize Service Learning: A Case Study in Construction Technology Abroad

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In Winter of 2019, members of the Associated General Contractors, Student Chapter at Cal Poly traveled to Selena, Belize to complete soccer bleachers at the local soccer field. This trip offered an excellent case study into feasibility and benefits of new construction technology on all project sizes and in different countries. SketchUp was used in multiple phases of this project including design, estimating and the creation of as-builts. Procore offers an array of useful features including the scheduling, daily logs and meetings that were used on this project. The scheduling feature was useful in tracking travel deadlines and for monitoring critical milestones to ensure that the project was completed within the travel window. Daily logs were instrumental in tracking material usage, production, deliveries and manhours that were way easier than the old fashion way of recording with pen and paper. The meeting feature automatically tracked, reminded and forwarded agendas saving valuable time through automation.

Key Words: Service Learning, Construction Technology, Procore, Sketchup

Introduction

Since the middle of last year, the students of the executive board of the Cal Poly, AGC Chapter planned and fundraised for a service-learning trip to San Ignacio, Belize. The planning began with outreach from one of our members, Will Myers, to his local community church which had been traveling to Belize for over 25 years to complete different projects for a small refugee community. Through planning, the team decided that an excellent project that fit the CM curriculum would be to construct bleachers and a shade structure at their community soccer field.

With this plan in mind, the team developed a budget to construct the project and get a team to Belize to build it. The first part of the project began in the budgeting phase. It was decided that a 3D model for the project should be made that would allow for the takeoff materials and compilation of the

material and cost estimate of the project. With that the team had to decide which 3D modeling software would be the best for this scale of a project. After considering both Revit and SketchUp, it was decided that SketchUp would be a better software with more design freedom and capability of editing on the go than Revit.

Getting familiar with BIM software does have a bit of a learning curve, but as one starts to get the hang of it, design goes smoothly. The first design did not include a shade structure and was not the complete design that was built. This preliminary design however was then used in the quantity take off and estimation steps of the planning process. The team's total estimate was \$18,795, broken up into building related costs and travel related costs. The construction industry was instrumental in funding this project as all the money for the project was raised through industry outreach and donations.

Procore Usability

Procore was introduced as the travel dates drew near and was instrumental in both pre planning for travel and construction. The schedule feature in Procore allowed for quick and organized management of vaccination dates, travel dates and the construction timeline on the group. Because the ambiguity in the conditions on the ground in Belize, the construction timeline was unknown to a certain extent. Rough dates and milestones were created before travel to ensure timely completion while on the ground in Belize.

The Belize team all had access to the project in Procore, allowing for easy and direct communication that is automated. Procore was also helpful in that it allowed for the creation of a travel/packing checklist to ensure that all team members brought the necessary gear with them to Belize. Also, some of Procore's standard checklists for quality control inspections and safety inspections are helpful on projects of all sizes. Regular and thorough inspections of our equipment was crucial to maintain safety and equipment longevity.

This project offered a real-life test for the use of Procore, a project and field management software. In conducting work in Belize, the use of Procore was instrumental in the success of a project. However, on the first day of construction, the online services of the Procore system were not accessible because of a failure in data roaming in Belize. Although not the ideal situation, daily activities were logged for the first construction day with pen and paper and some assistance in the offline version of Procore. The handwritten experience of logging daily activities, deliveries and productivity was not difficult for one day but would quickly become very hard to track. This is the old way of how Superintendents use to make daily logs on even the largest jobsites. Slowly overtime, this system of jobsite monitoring and recording has developed into an online process where access and recording keeping is automated. Now, companies like Procore can track all of this information and store it by date, time, weather or even major events to better organize and track jobsite activity.

Tracking employee productivity on this project was crucial for a couple of reasons. The project team from Cal Poly wanted to track specific hours with the goal of reporting manhours that are required for such a project. Also, the team had assistance from both community volunteers and skilled labor that was to be tracked to either compensate the worker or record in the total amount of manhours for the production on the project. With the Procore system, individual and company manhours can be easily tracked and automatically calculated saving copious amounts of time and energy.

Upon departing for Belize, the team was not sure that the shade structure would be a possibility. The group lacked the knowledge of available materials (a common trend), the knowledge of site conditions and tool availability. Even once the team arrived, there was skepticism if the shade structure was going to come to fruition. After completing a majority of the concrete work, the first workday, the decision was made to complete the shade structure. The design came together through a meeting with Juan, the local builder, and members of the Cal Poly building crew. The design was sketched out on a piece of paper, much like an addendum, and was built off that. When constructing in the United States, this would have been an easy thing to model in a 3D software and then construct. The lack of useable technology in this case goes to show how crucial the available building technology has come to be in the domestic construction industry.

One of the most useful services that Procore provides is its meeting tracking and agenda building feature. This feature allows the meeting manager to create a meeting, invite attendees and build the agenda. Also, after the conclusion of the meeting the feature will automatically distribute the notes and agenda to all other people on the list, if they have Procore or not. This service was a very helpful feature to track our meetings both before and during the construction phases of the project. Although a small project with a duration of a week, this is definitely a scalable service that would benefit projects of all sizes to track and document meetings.

Construction Reflection

This project was a great opportunity for the team to gain hands on construction knowledge and truly understand aspects of building that we do not necessarily have built into the curriculum. This was a great opportunity to see the major building difference between what I have learned for building in the United States compared to what other developing nations struggle with. One of the biggest challenges to building here in America is the hoops that you have to jump through to get projects underway and the bureaucratic systems projects face when in the construction phase. As for in Belize, they face far different issues including theft, vandalism, lack of correct building materials and adequate funds for project completion. To combat, these Belizean workers are very innovative in their means and methods. For example, instead of using concrete mixers, the workers pour a little concrete slab on the ground. On that slab they lay out a sand base aggregate and create a mote with it. Then, they add cement mix and water and mix it in a fashion like one would make homemade pasta.

A struggle that we faced throughout the project was the lack of quality building materials. Although most materials were accessible, the building supply stores were not organized like that of the America and did not have common materials. One of the biggest struggles our team faced in construction was in the forming and pouring of the rear columns that supported the shade structure. Because of a tight budget and lack of material availability the columns were formed with sonotube, scrap wood and tie wire bracing. With careful pouring, the first two columns went rather smoothly when an assembly line was created to fill and pour buckets of concrete into the columns. However, part way through the day, it began to rain, and this led to all kinds of problems. When the cardboard sonotube got wet, its strength weakened greatly causing a blowout on the third column. Although several attempts were made to save the sonotube, it failed, and concrete poured out everywhere. Since the columns were a critical path task, it had to be completed that day. Our team used a new sono and braced it all the way up with scrap wood and CMU to secure structural integrity creating strong enough formwork to make it work. This was a valuable lesson to all members of the team that construction is about meeting deadlines and finding out ways to make it work.

Conclusion

One of the most important lessons learned from this trip is the key to building a successful team is choosing people that can face difficulties and find innovative ways to overcome those issues. Team chemistry and comradery is crucial to creating environment where everyone feels comfortable sharing their opinions and giving feedback to one another's ideas. In service-learning projects to foreign locations, there will always be difficulties that present themselves so having the ability to overcome is essential. Another important lesson learned from this project is that padding the budget is advisable no matter how detailed the estimate is because there are always unforeseen conditions that will require extra money. Some of the unexpected conditions that required more money than in the original budget on this different hardware, faulty materials (i.e. tapcons), etc. Although the main language in Belize is actually English, the community and local populous that we partnered with spoke mostly Spanish. Our main point of contact, Juan Peralta, was not a native English speaker causing some language barriers surrounding the construction industry. For future planning, it would be advisable to brush up the main language or bring a speaker of the language as an intermediary. Before leaving, the team did one mockup where materials were tested and the necessary skills for laying CMU blocks were revisited. This was a super helpful task to conduct before leaving for Belize, but looking back, it would have been beneficial to test a few more things in a mockup. In Belize, the plan was to use tapcons to secure the boards to the stringers but that ended up not working. Instead it was decided that mechanical anchor bolts would be better to secure the boards and thus the change was made on the ground. This change had the potential to be avoidable if we had built just one step of decking before travel time.

Service work-study programs allow for the students that attended the trip to learn valuable knowledge of the construction industry and to grow as individual members of the world. Not only was this project a good opportunity to learn new construction techniques but a great opportunity for the members of the team to gain worldly knowledge and perspective. Also, in the planning and execution of the project the team learned valuable insights on the difficulties of planning and building abroad. One of the biggest struggles was trip approval time with the university. What this means is that moving forward, AGC student chapter members have first-hand experience with both planning and scheduling to ensure that the trip is completed within time constraints. Essentially this trip can act as a manual for the club to plan trips in the future.

The innovations made in recent years in construction technology make projects all over the world easier, from the smallest project, to the largest project. This project was an excellent case study for the use of such software and their ability to streamline, visualize and construct projects successfully. Procore is one of the top project management software in the world, known for its user-friendly interface and its ability to integrate with all kinds of other programs. Procore on this project was instrumental in preplanning, construction planning and construction execution. One of the best features of Procore's field management side that is on display is the daily log feature that quickly and automatically tracks material usage, production, inspections, etc. A discussion about construction technology would not be complete without an inclusion of some sort of 3D modeling/rendering software. Sketchup Pro was key in assisting multiple phases of this project from preliminary visualization to estimation through design changes and building. The interface of this software is very basic yet still creating a powerful program with many key features to design bringing an idea to fruition.

Appendix & Figures

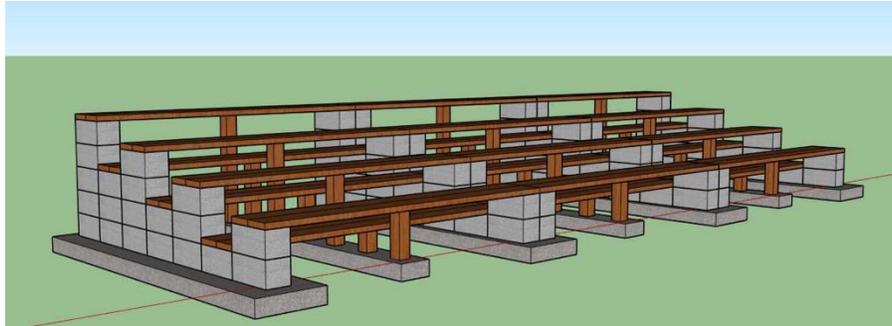


Figure 1. Preliminary SketchUp design used for budget estimate

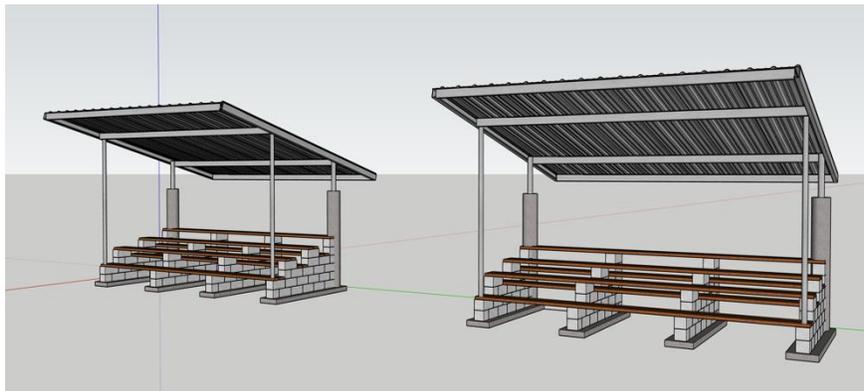


Figure 1b. Final SketchUp design edited with inclusion of shade structure



Figure 1c. Final Lumion rendering of structure constructed in Selena, Belize

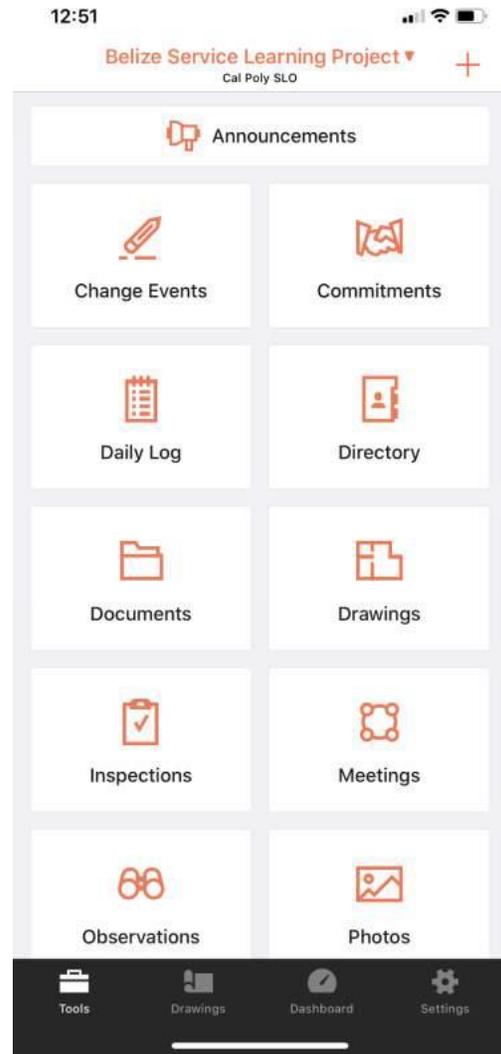
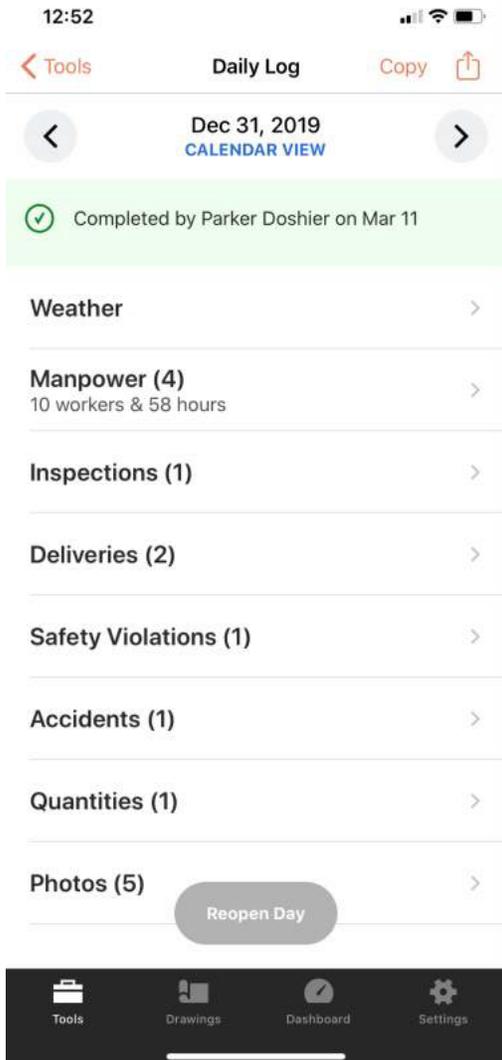


Figure 2. Screenshots of Procore Phone application showing easy navigation and filing.



Figure 3. Photo of south bleacher complete on the day of opening ceremony.

Daily Log: Tuesday 12/31/2019


Daily Log Completed
 The Daily Log was completed by Parker Doshier on Wed Mar 4, 2020 at 08:18pm CST.

WEATHER REPORT

Temperature			Precipitation Since			Humidity				Windspeed		
Low	High	Avg	Midnight	2 Days Ago	3 Days Ago	Low	Avg	High	Dew	Avg	Max	Gust
21°C	29°C	24°C	0.22 cm	0.41 cm	0.44 cm	74%	90%	100%	22°C	5.3 kmh	11 kmh	19 kmh

DAILY SNAPSHOT

06:00AM	09:00AM	12:00PM	03:00PM	06:00PM	09:00PM
partly-cloudy-night 22°C	cloudy 25°C	partly-cloudy-day 29°C	partly-cloudy-day 28°C	partly-cloudy-night 25°C	partly-cloudy-night 22°C

OBSERVED WEATHER CONDITIONS

No.	Weather	Delay	Sky	Temp	Average	Precipitation	Wind	Ground/Sea
1	No							

MANPOWER LOG

No.	Contact/Company	Workers	#	Man	Location
		Hours	Hours	Hours	
10 Workers 58.0 Man Hours					
1	Cal Poly Belize Crew	7	6.0	42.0	
Notes: -2x6 Lumber boards placed -Shade structure column rebar cages built -sonno tube formwork placed and braced -columns poured with some minor issues					
2	Bricks Unlimited	1	5.5	5.5	
Notes: -able there to help during earlier hours -builds cage with Selena Contracting					
3	Selena Contracting	1	5.5	5.5	
Notes: -Juan there all day helping with board placement					
4	Selena Contracting	1	5.0	5.0	
Notes: -Robin there helping build rebar cages -helping complete placement of column concrete					
		10		58.0	

Manpower Log's Attachments:

INSPECTION LOG

No.	Start Time	End Time	Inspection Type	Inspecting Entity	Inspector Name	Location	Area
1	10:50AM	11:20AM	Concrete		Juan Peralta		
Comments: -first column concrete places and inspected so that construction of remaining columns can begin							

DELIVERY LOG

No.	Time	Delivery From	Tracking Number	Contents
1	08:35AM	Selena Contracting		-2x6 Lumber boards all delivered to site
Comments:				
2	08:50AM	Excel Construction		-All formwork and rebar delivered to site
Comments:				

SAFETY VIOLATION LOG

No.	Time	Subject	Safety Notice	Issued To	Compliance Due
1	10:30AM	Scaffolding		Selena Contracting	1/1/2020
Comments: Scaffolding built for concrete placement would not become stable and not pass inspection for use					

ACCIDENT LOG

No.	Time	Party Involved	Company Involved	Comments
1	11:40AM	Parker Doshier (Cal Poly Belize Crew)	Cal Poly Belize Crew	-Blowout of sonno tube because of rain

[IMG_3591.HEIC](#)

QUANTITY LOG

No.	Cost Code	Location	Units	Quantity
1	03-000 - General		Cubic Yards	2.0
Comments: -2 cubic yards of concrete used for columns				

PHOTOS



Figure 4: PDF export from Procore showing organization and uniform documentation for all daily logs.