Prefabrication of Exterior Partitions for Great Northern Services

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In the wake of a fire in Weed, CA that destroyed 150 homes, a non-profit organization called Great Northern Services (GNS) reached out to Cal-Poly San Luis Obispo about a service-learning opportunity that involved designing a single-family home and pre fabricating the exterior partitions in San Luis Obispo. In Fall 2017, interdisciplinary teams of students delivered design proposals in the Integrated Project Delivery studio. The selected design was then finalized into a permitted set of drawings and planning for the prefabrication began. The extent of the prefabrication was limited to the framing and sheathing of the exterior walls. The length of each panel was changed from 6'-11" to a custom length for each to optimize panel weight, material usage, and maintain the studs at 16" on center. The prefabrication took place in the Simpson Strong Tie Demonstration lab at Cal-Poly, where space was allocated between other building labs and projects. An estimate was prepared, and material was sourced from a local lumber supplier. The panels were stacked in the construction management plaza as they were built. They were loaded vertically into a 40-foot shipping container, which was then shipped to the project location.

Key Words: Prefabrication, Modular, Residential, Carpentry, Planning

Reflection

The planning, estimating, scheduling, and prefabrication of these exterior walls for the Great Northern Services was an eye-opening type of project as well as a project filled with lessons throughout the two quarters. Working with two other students and a professor expanded my knowledge with construction, teamwork, and skills. This senior project had a lot of lessons that we learned in various classes here at Cal Poly. These lessons learned in class were more emphasized since this was an actual project with money, an owner which was GNS, and a schedule that needed to be in track since we only have twenty weeks in two quarters.

A breakdown of what we did during winter quarter 2019 consisted of brain storming of what needs to be done within the next two quarters, how much material we need for the project, align our material list with the lumber companies' catalog, create spool drawings for each panel, looking for construction sites and storage close to Cal Poly, equipment, transportation of panels, logistics plan, and a safety plan. The breakdown of what we did during spring quarter 2019 consisted of building these exterior partitions, creating a stage to build, a container delivery, placing the panels into the container, and shipping the container to Weed, CA.

We started by planning on our approach during the start of Winter quarter of 2019. At the start of our first meeting, I didn't really know what to expect because this process was new to me and have not had this much experience in the construction side had me thinking what is the steps we take in order to achieve the goals for this project. The planning process started by creating a deliverable list of certain tasks broken down for Winter Quarter and Spring Quarter. Winter quarter was spent majority with quantity take offs, a pre-construction schedule, construction schedule, material procurement, material management, construction and storage location, labor planning, QA/QC plan, and execution plan. During this quarter was more of getting set up for the building process during Spring 2019 and the essential items that are going to be needed for the project. After the first meeting we had, I learned that so

much goes into planning to construct a project as well as it took different brains and people to think of the items that needed to be accomplished for the next two quarters.The first task that we worked on was the schedule and quantity take off. Jeremiah did the schedule while Patrick and I worked majority on the take off. Reading the plans and understanding the materials required for the project was not hard to read at all due to all the practice we had in all our lab classes here at Cal Poly. After finishing up the take-offs, we as a group discussed ways to reduce cost, reduce material, and ways to be more efficient. We compared the various panel sizes from the current state of the plans, a 6'-8" alternative, 8' alternative, and a custom length alternative by how much sheathing we would waste, wood waste, 16" spacing, pounds per foot, and how many people could carry a panel. When we did this exercise, I never would have thought of making an alternative plan if I was by myself because I never learned this in a classroom experience. This part of the planning opened my mind about the different factors that you, as a construction manager, has to think of and finding out the best ways to deliver while being the most efficient team when constructing a project.

One of the deliverables that we the students, did not think of was the spool drawings. In one of our meetings, Greg was talking about making some type of instructions or spool drawings for each panel we are going to build. This was another part of the project that I was very curious because I never have heard this before in a classroom setting. We eventually did these spool drawings by dividing up the work and worked on our specific panels. It took time for me to learn Revit again since it has been a couple years. Once we did it a lot of times, the process of redoing it and checking it was easier over time. These drawings eventually made the process of building easier during spring quarter since it had all the measurements we needed, the lengths that needed to be cut, and the sheathing needed on which studs. This was one of my favorite parts of the planning phase because I could see how much material we need for each panel, makes our process flow easier, new knowledge, and know the components of how each panel fits in with each other.

Another part of our project was creating different plans and proposals. Those were proposals to using the Simpson Strong Tie demonstration building as a place to build and store materials, a safety plan, and logistics plans. I learned that we had to figure out a place to store and work on our panels, but did not expect making a document to use the Simpson Strong tie demonstration building because I assumed that since we were construction management students that we could use the building. Since it is a high profile project and the school does want to keep a good reputation and keep the safety of its students, our team had to give them our plan when working on this project. We included safety considerations, duration of the project, equipment, and space required. This taught me that you have to keep in mind certain parameters in a school and that you have to have a plan that is safe and smart. Just like any construction company, we created a safety plan that made sure we had the right procedures, safety wear, and preventative measures. We as a group wanted to emphasize safety since we did not any one hurt during our project. At the end of our project, no one got hurt meaning that our safety plan worked out well. Creating this document opened my mind to different scenarios that could happen in the job and be more aware of what we do during our project. And lastly, our logistics plan made for our lifting rig operator to know how we are going to move each panel closer to our container and the process. All these plans and proposals taught me that there are so much documents that you as a construction manager has to create to let certain people know about the usage about a location, equipment, safety of the site, the certain processes you are going to take, and many more depending on different situations.

The first task that I took during spring quarter 2019 was accepting the delivery of wood from our supplier. This was the first time that I had to make sure our order was right by counting the lumber and sheathing. I only learned this in class, but accepting and making sure we had the right material was good to know because we definitely did not want any wrong material or less material than expected.

The second week of spring quarter was the first time we were building and we started off by creating our stage. We had challenges of just being slow because its been awhile since we,students, touched tools. We had a few bent nails and this was the day we did not have any power tools. The next five weeks were just building on friday for eight hours. Each week, we ranged from three to five people working depending on certain events that we all had. The first two weeks of building the panels were probably the roughest and hardest weeks since we had problems with our nail guns, wrong inserts for our hoses to compressors, and wrong nails. Even if we had these problems, we still wanted to be the most productive we could be and using a hammer and nails was the best option during those weeks.

It has increasingly bettered my skill as a carpenter on how to hammer, cut wood, measure, and nail. Greg and Joe really helped our skills by teaching us certain tricks like putting a nail on the stud and bending it so it could hang off the top or bottom plate, use certain equipment properly and safely, make sure our panels our even by measuring out from corner to corner, and just be role models when working.

Once we got all our equipment working the way it was intended, the next three weeks were getting easier and more productive. Each week, we were able to produce one more panel than the previous week. We divided up the work which made production even faster. I would create headers and cut the lumber, Jeremiah and Patrick would lay all the materials and nail them on our stage needed for that panel, Joe supervised and helped wherever needed, and Greg did the layout of each top and bottom plates. Creating a system that has everyone doing a certain task increases the productivity within the group while getting better at that task.

We moved each panel one by one outside by using furniture dollies. We over thought of ideas of how to carry these panels at the beginning by getting certain rigs and other pieces of equipment, but the easiest and most efficient solution was just by putting them in dollies then carrying them once we got closer. This taught me that you can think of the most complicated way at the beginning of the process,but once you actually get to that certain task you think of better ways to solve that problem.

Once the container came, we all felt good because we are almost at the end of the project. We were able to load up the container safely and efficiently the following day. During this process of loading up the container, I was able to use my knowledge from our heavy civil class by doing certain hand signals while working with a crane operator. That great using some part of class and applying it in a real scenario. The following Monday was supposed to be the day our container gets picked up by the shipping company. There was some type of miscommunication between all the sides of the project and the shipping company. One thing to note here is that not everything comes into place especially in the end. We communicated with different companies and found another that could move that container for us. We have to change plans to remove our panels from the container then have the crane carry the container onto the flat bed and then carry the panels back into the container.

The prefabrication of these exterior walls for Great Northern Services was an exciting opportunity for me. I definitely learned so much from doing quantity take offs, safety plans, logistic plans, building the panels, using Revit,using excel, communicating, and a lot of problem solving. This senior project showed me that construction is a team effort and you cannot do this process by yourself. Senior projects like this will definitely emphasize things you learned in classes. Some classes that I took away lessons from and applied it in this project were residential construction, commercial construction, jobsite, and BIM. Some key takeaways from the project are: respect the trades people because they really are talented and hard working people, planning is very important in any project you take on in the future, find the best way to stay efficient and within budget, have alternative plans in case of your other plans do not work out, and lastly is listen and learn from more experienced professionals.