Implementing Weekly Work Plan Lab into CM 214 - Residential Construction

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A schedule is one of the primary components of any construction project and can determine the success of a job. Schedules most often contain high-level line items and lack the details it takes to actually implement daily work in the field. Subcontractors, as the specialists, understand the myriad of smaller tasks that a master schedule omits. It is the job of a superintendent to extract this information from subcontractors during pull plans, to build precise schedules, called weekly work plans (WWP). At Cal Poly it is expected that students receive a well-rounded curriculum in how to build various types of schedules. The CM 214 Residential class builds a Tiny House to help students understand the basic steps in building a home. The class does an excellent job teaching through learn-by-doing, however, there is always room for improvement. The proposed class module is centered around a WWP lab, where the goal is to enhance student learning outcomes and prepare students for their careers. The WWP lab was devised from an internship experience, working for Turner Construction at the LA Stadium at Hollywood Park. A WWP is a more detailed schedule than a traditional schedule, which is utilized by superintendents to build and track their work. In the lab, students will be responsible for filling out the WWP before they start building and then track the progress of their work throughout the day. This assignment will help students to increase collaboration, accountability, understanding of the complete building process, and to limit rework.

Key Words: Weekly Work Plan, Last Planner System, Daily Huddle, Inspection, Tiny House,

Background

Last Planner System ®

The Last Planner System which is used by Turner Construction is composed of four steps: contract schedule, phase pull planning, weekly work planning (WWP), and daily huddles. These steps are derived from LEAN construction principles, where the goal is to increase efficiency in the field while maintaining quality standards. Starting with the contract schedule, which is developed at the very beginning of the project, the scheduler builds a master schedule containing a list of high-level tasks categorized under various milestones. This schedule often leaves out smaller-less-important tasks which are key in the building process. The next phase is pull planning, which depends on all subcontractors who are involved in completing a portion of the project gathering to sequence tasks. The superintendent will then have each subcontractor write the name of their specific task, it's duration, and what preliminary tasks need to be completed first. Then, working backwards, they create a timeline for completing the line items. To summarize, they pull tasks and plan a schedule together.

Once all activities are correctly sequenced, the superintendent will use this data to build a more detailed schedule and a WWP. This is a detailed schedule showing all of the activities that are expected to be completed during a given week. The WWP should be started midweek for the following week and be sent out to the appropriate subcontractors. The target of the WWP should be to hit 80% of the tasks that are listed. An 80% completion goal was established because a smaller percentage would imply that the WWP has unrealistic expectations; a higher percentage of completion would imply that the schedule is not rigorous enough. It is important to find a good middle ground for these conflicting dilemmas, so that subcontractors can be pushed to complete their work effectively. Lastly, daily huddles are used in conjunction with the WWP to coordinate changes in the schedule. This 30-minute meeting also allows for subcontractors to bring up any potential constraints that may hold up work. This planning process encourages subcontractors to coordinate with each other instead of only going to the superintendent for answers. Daily huddles can be held in the morning, or afternoon, and should have at least one representative from each trade present.

How the Project Came About

During my internship working for Turner Construction, on the LA Stadium, I was exposed to the WWP and its LEAN application. I was working as a superintendent intern, primarily coordinating with subcontractors and tracking work progress. Throughout my time at Turner I was able to see the various benefits of the WWP. When I started there, the superintendent I reported to, was not using a WWP system to schedule and track work. Over the course of the summer, we began to implement it by having subcontractors fill out what they planned to complete each week. We began to implement daily huddles, for the subcontractors to coordinate work and clear any potential constraints. I began to see a very clear transformation in the way that subcontractors began to communicate with one another. They began to work more effectively together and created a more natural work flow. I would track the reasons why certain activities would be delayed, such as prior work not being completed, or weather conditions. We would then strategize to minimize these issues to continue an efficient work flow. By the end of the summer, the subcontractors had completely bought into the WWP and daily huddles, making the system effective and successful.

Concurrently, I was enrolled in the CoOp course at Cal Poly, which allowed me to reflect on my internship by reflecting on each work day and logging my thoughts. I began to see how important the WWP was to our project and how the Cal Poly curriculum does not have any similar teachings. After further review and discussion with professors, I decided to integrate the WWP into the Tiny House Lab.

Lab Instructions

Before First day of Building– Filling Out the Weekly Work Plan

To begin the lab discussion, the professor should go over the purpose of the assignment, what the Last Planner System is, and the assignment's deliverables (See Appendix A). The purpose of the assignment is to increase student understanding of the building process, accountability, and scheduling knowledge. Once students understand what is expected of them for the assignment, the WWP paper can be distributed (See Figure 1). Please note, that the headings listed in the WWP align with those listed in the Tiny House packet.

Each builder group will be given one WWP sheet, with the first five tasks filled out under the foundation heading, prior to beginning the building process. Each builder group will fill out the WWP with what the class is expected to complete on the first day of building – not just the tasks completed by their own group. For the first day of the building process, the WWP will act as a trial run for students to complete one. Builder groups will refer to the Tiny House Construction Packet to fill out the WWP, as detailed as possible. Students should examine the tasks given under the foundation heading as an example of how detailed they need to be, and what formatting they should follow. Students should focus on when inspections for squareness, openings, and nail spacing are necessary, as well as the sequence of activities. Students are to fill out the "Task Description," "Group/Inspector," "Name," and "Weekly Work Plan" sections before the start of the first day. For intermediate inspections, such as checking if the mudsill is square, students should write their team captains name under the "name" column. The professor will only conduct final inspections at the end of each milestone category.

Under the weekly work plan column, students are to mark with an "X" for general tasks or an "I" for inspections to signify work that will be completed that day. Once all of the information above is filled out, students are ready to start building.

Plan Starting On:

CAL POLY

Date:_____

CM 214 Residential Constructon

GROUP NAME: _____

X	Task Complete
I	Inspection

TASK DESCRIPTION	GROUP/INSPECTOR	NAME	WEEKLY WORK PLAN					IS THE WORK COMPLETE PER PLAN?		NOTES
			Day 1	Day 2	Day 3	Day 4	Day 5	YES	NO	
			Monday	Tuesday	Wednesday	Thursday	Friday			
			Is the task in the right Sequence?							*What has been Learned to Improve? Share Learning.*
Foundation										
Layout Foundation										
Install Anchor Bolts										
Install Mudsill										
Inspect Mudsill is Square										
Install Rim Joist										
Wall Framing										
North Wall										
South Wall										

Figure 1. Student Weekly Work Plan

During the First Building Day

At the start of the first day of building, each builder group should huddle to discuss what they will build that day. Over the course of the day, group members should check in on the progress of other groups, in addition to tracking their own progress. The WWP should not be altered once building begins, each day. It should be utilized as a checklist to make sure that the work is being completed in the correct sequence, and no steps are being skipped.

At the End of First Building Day – Reviewing the Weekly Work Plan

At the end of the day, each builder group will reconvene to finish filling out the WWP. They will now fill out the "Is the Work Complete Per Plan" and "Notes" column. Under the "Is the Work Complete Per Plan" column, students will simply put an "X" under the "Yes" heading, only if the entire task was completed during that day. If a task was partially completed students will put an "X" under the "no" column and leave a comment as to why the task was not done in full. The "notes" column should be focused on learning outcomes, ways to improve the WWP, and building process. It is not necessary to leave a note for every task.

After each group has had adequate time (approx. 5 minutes) to go over their WWP, the professor will discuss the *master* WWP with all the groups. The professor will preface the discussion by saying that there is no correct WWP. Every groups WWP should be different. Reviewing the *master* WWP should give students a better idea of what is expected of them for the remainder of the quarter. While reviewing the WWP with the class, the professor should focus on discussing the sequence of activities and inspections, the wording of activities, the durations, and general learning outcomes. Some questions the professor may want to ask to start the discussion could be: "Did you forget any important tasks that I have shown above?", "Was your sequence of activities correct?", "Were you able to track the progress of the other groups?", or "What did you learn today overall?" The professor should let the students speak as much as possible to each other in a class dialogue, instead of a lecture style discussion.

Second Day of Building

The second day of building will begin with each group huddling to fill out the remainder of their WWP. This will act as their concrete schedule for the rest of the week, and no alterations should be made retroactively. Each group should think back to what they learned in the review of the first day's WWP as a gauge for how they can improve their own. Students will follow the same steps as stated under the *During the First Building Day* section. At the end of the second day of building students should still huddle to discuss their WWP, however, the professor will not be going over the plan.

End of the First Week of Building

At the end of the first week of building the professor will take time to reconvene with all the groups to discuss their WWPs. This discussion should be more in depth as the students should have a greater understanding of what is working for their groups. Students should discuss any problems they may be having and give feedback to the professor. The professor will collect the WWPs to review and grade.

Last Week of Building

At the beginning of the last week, each builder groups will complete their WWP for final week of building. Builder groups will follow the same procedures of the first week's WWP. At the end of the week, the professor will go over the *master* WWP and recap the assignment. Students should have a good understanding of what a WWP is and what the benefits of it are. The professor should extrapolate how the overall construction industry uses a WWP, and how it can be successful outside the classroom.

Lab Proposal

Current Class Content

Currently, the class prepares for the building process by watching videos online of workers constructing a residential house and paying attention to the professors lecture. The video shows all the steps of the building process from installing the foundation to finishing the drywall. After watching these videos, students are given two packets: *Tiny House Construction Packet* and the *Simpson Strong-Tie Structure Lab*. The *Tiny House Construction Packet* is comprehensive and shows all the steps and checks necessary to successfully build the tiny house. While the *Simpson Strong-Tie Structure Lab* shows all the elevations, sections, and plan views for the tiny house. Students are told to review the two packets and come to class prepared with the knowledge on how to build. The class is then broken up into 5 groups, each group having a team caption. The project is a two-week process that is split between week four and week seven.

Learning Objectives

In an effort to develop a well-rounded and useful curriculum, I wanted to devise the WWP assignment based on my internship experience, and conversations with professors and students. The goal of the assignment is to increase collaboration, accountability, understanding of the complete building process, and to limit rework. Students should finish the lab with a greater understanding of what a superintendent's responsibilities are and how a WWP can be utilized effectively. The WWP will also teach students how to schedule work, create accurate durations, and track their progress in an organized manner.

Problems and Solutions: Improvement in Learning & Accountability

This section will discuss the various issues with the current construction process and how these issues can be remedied with the proposed WWP lab. There are also a multitude of ways to increase student learning which are analyzed below. The goal of this lab is not to merely add another lab to the course as busy work, but benefit student

learning outcomes, while increasing building efficiency. The conclusions drawn below are from personal experience in taking the course, observing and speaking with students that have taken the course, and discussing the curriculum with the professor.

1. With the class broken up into 5 different groups, in charge of different parts of the building, individuals are not always exposed to the entirety of the building process. Students are unable to build every part of the tiny house and aren't aware when certain inspections are necessary and quality checks occur.

    a. With a WWP, students will fill out the sequence of activities and inspections needed for every task of the tiny house. For example, even if the group is not constructing the roof, they will still fill out every task necessary to complete the construction of the roof. This will teach students about all aspects of the building process. Students will also need to collaborate with other groups to track the different line items on their own WWP.

2. Students do not always pay attention in class or read the entire "Tiny House Construction Packet." This inevitably leads students having a lack of understanding in how to begin building the Tiny House. Groups often have a gap in understanding between the team captain, who has a great understanding, and a couple students don't actively participate.

    a. The WWP lab will allow students to make a detailed schedule of what will be completed during each day. This will help hold students accountable to understand the sequence of tasks. Students will also hold brief daily huddles at the beginning and end of the building process, getting them on the same page for what they are constructing that day.

3. The professor has to watch over the whole class at once, instead of the students being held accountable. The workload of checking various openings, minimizing mistakes and rework, and increasing safety, falls upon the professor and not the student builders. This does not mimic a real work environment, where subcontractors are responsible for their own work.

    a. With a WWP detailing out what inspections need to be executed after each task, by the group foreman, rework will be decreased. Having a detailed schedule that accounts for inspections at the proper time, allows students to develop a roadmap of what they need to do every step of the way, and minimizes the professors need to micromanage.

4. Increasing scheduling knowledge.

    a. Before starting the build, students will think critically about which steps need to precede and succeed each other. Students will huddle very briefly at the beginning and end of each day to go over the WWP, and make sure they are staying on track with the schedule they have developed.

Conclusion

Overall, implementation of a WWP lab will benefit the students and the professor. This exposure to another type of scheduling assignment, in addition to the current Construction Management curriculum, will expand student knowledge. Students will be more adept in the role superintendents play managing trades. Even if students are not on a superintendent track, it is in their best interest to have a basic understanding of how superintendents track work and create a work flow. Additionally, by having the management responsibilities of the professor dispersed, it frees up the professor to focus on learning objectives and answering questions as they arise. Teaching students how to effectively utilize a WWP will help to develop a skillset, and deeper understanding, of the building process that can be projected into the outside world.

CAL POLY

Construction Management
College of Architecture & Environmental Design

Weekly Work Plan Lab

ASSIGNMENT:

In your build group, refer to the "Tiny House Construction Packet" and "Weekly Work Plan" documents. Use the images and text from the "Tiny House Construction Packet" to identify the correct task sequence, and durations to fill in the weekly work plan. The weekly work plan will act as a superintendent's schedule, which will follow each necessary step and track inspections needed to build the tiny house.

Now, look at the weekly work plan document titled, 'Foundation' milestone as an example of how to create your weekly work plan **for this week's** portion of the build. Remember that the weekly work plan must include all relevant inspections and include all steps in the building process, not just those required for your group. At the end of each building day, track what was completed by filling out the '(Y/N)' column and 'Notes' section.

DELIVERABLES:

1. Identify the correct sequence of activities. Be as detailed as possible.
2. Identify important inspections (i.e. square, nail spacing, heights, openings).
3. Write the tasks down on the weekly work plan, checking boxes for each duration.
4. Meet with your build group to discuss which activities are expected to be completed, based on the weekly work plan, at the start of each work day.
5. Track each groups' progress **every day**. Be sure to account for each activity written down on the weekly work plan.

EXCELLENCE:

- Having a highly detailed sequence of activities in correct order.
- Correctly identifying when inspections are necessary.
- Properly tracking tasks with (Y/N) and 'Notes' section.

DUE DATE: End of each week of building.

Plan Starting On:

CAL POLY

Date:_____

CM 214 Residential Constructon

GROUP NAME: _____

X	Task Complete
I	Inspection

TASK DESCRIPTION	GROUP/INSPECTOR	NAME	WEEKLY WORK PLAN					IS THE WORK COMPLETE PER PLAN?		NOTES
			Day 1	Day 2	Day 3	Day 4	Day 5			
			Monday	Tuesday	Wednesday	Thursday	Friday	YES	NO	
			Is the task in the right Sequence?							*What has been Learned to improve? Share Learning.*
WEEK 4										
Foundation										
Layout Foundation	Group 2	Sarah	X							
Install Anchor Bolts	Group 2	Sarah	X							
Install Mudsill	Group 2	Sarah	X							
Inspect Mudsill is Square	Group 2	Team Captain	I							
Install Rim Joist	Group 2	Sarah	X							
Inspect Rim Joist is Square	Group 2	Team Captain	I							
Install Floor Joists	Group 2	Sarah	X							
Install Subfloor Sheathing	Group 2	Sarah		X						
Final Inspection	Inspector	Eric Brinkman		I						
Wall Framing										
North Wall										
Layout Wall & Window	Group 1	John	X							
Inspect Layout	Group 1	John	I							
Nail Header, Jack Stud, Sill Plate, Top Plate, Bottom Plate, Studs	Group 1	John	X							
Final Inspection (Openings, Dimensions, Square) & Install Cross Braces	Inspector	Eric Brinkman	I							
South Wall										
Layout Wall & Door Opening	Group 2	Sarah	X							
Inspect Layout	Group 2	Sarah	I							
Nail Header, Jack Stud, Sill Plate, Top Plate, Bottom Plate, Studs	Group 2	Sarah	X							
Final Inspection (Openings, Dimensions, Square) & Install Cross Braces	Inspector	Eric Brinkman	I							
East Wall										
Layout Wall & 2 Windows	Group 3	Bill	X							
Inspect Layout	Group 3	Bill	I							
Nail Header, Jack Stud, Sill Plate, Top Plate, Bottom Plate, Studs	Group 3	Bill	X							
Final Inspection (Openings, Dimensions, Square) & Install Cross Braces	Inspector	Eric Brinkman	I							
West Wall										
Layout Wall & Window	Group 4	Kellen	X							
Inspect Layout	Group 4	Kellen	I							
Nail Header, Jack Stud, Sill Plate, Top Plate, Bottom Plate, Studs	Group 4	Kellen	X							
Final Inspection (Openings, Dimensions, Square) & Install Cross Braces	Inspector	Eric Brinkman	I							

Plan Starting On:

CAL POLY

Date:_____

CM 214 Residential Constructon

GROUP NAME: _____

X	Task Complete
I	Inspection

TASK DESCRIPTION	GROUP/INSPECTOR	NAME	WEEKLY WORK PLAN					IS THE WORK COMPLETE PER PLAN?		NOTES
			Day 1	Day 2	Day 3	Day 4	Day 5			
			Monday	Tuesday	Wednesday	Thursday	Friday	YES	NO	
Wall Assembly & Sheathing										
Tilt Up Walls	Group 2	Sarah		X						
Plum & Square Walls	Group 2	Sarah		I						
Install Double Top Plate & Cross Braces	Group 2	Sarah		X						
Final Inspection (Plum & Square)	Inspector	Eric Brinkman		I						
Install Wall Sheathing	Group 3	Bill			X					
Cut Out Window Openings	Group 3	Bill			X					
Inspect Nail Spacing	Group 2	Sarah			I					
Roof Framing										
Layout False Top Plate (Roof Frame)	Group 4	Kellen			X					
Inspect False Top Plate is Square	Group 4	Kellen			I					
Install Ridge Board With Rafter Clips	Group 4	Kellen				X				
Install Roof Rafters	Group 4	Kellen				X				
Install Bird Blocking & Wire Mesh	Group 4	Kellen				X				
Install Fascia Boards	Group 4	Kellen				X				
Install Roof Sheathing	Group 4	Kellen				X				
WEEK 7										
Install Drip Edges On Horizontal Fascia	Group 2	Sarah	X							
Install Building Paper	Group 2	Sarah	X							
Install Drip Edge on Raked Fascia	Group 2	Sarah	X							
Install Starter Strip, Shingles & Ridge Cap	Group 2	Sarah	X							
Lift Roof	Facilities	Will	X							
Exterior										
Install House Wrap	Group 2	Sarah		X						
Install Windows & Flashing	Group 2	Sarah		X						
Install Door	Group 4	Kellen		X						
Install Gable End Framing & Sheathing	Group 4	Kellen		X						
Install Gable House Wrap	Group 1	John			X					
Install Siding & Z-Flashing	Group 1	John			X					
Cut Openings for Under House Ventilation	Group 3	Bill			X					
Install Trim around Windows & Corners	Group 3	Bill				X				
Install Trim Around Door	Group 4	Kellen				X				
Final Inspection (Finish Project)	Inspector	Eric Brinkman				I				