Standardizing Hands-on Building Activities in Commercial Construction Management and Recommendations for Semester Conversion Adaptations

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CM 313 Commercial Construction Management at Cal Poly is an integrated lab course and one of the main hands-on learning experiences construction management students participate in. It is currently administered in the quarter system and as the university transitions to the semester calendar, the lab needs to be converted in order to accommodate this change. The main purpose of this project was to document existing practices and improve the process and experience for students, instructional students assistants, Simpson Strong Tie coordinator, and other professors of CM 313. This project included creating a builders guide to help the student assistants by developing a materials specification manual for the SST coordinator, a guidebook comprising each step of the construction process from formwork through reclamation and demolition. It includes materials, processes, and images. The SST coordination sheet is composed of all required materials for the CM 313 lab with quantities, location of purchase, purchase by dates, and image references. This project provided changes to the course as it converts to the semester schedule. The proposal for semester conversion includes recommendations for future location of a new strong frame, potential lab schedules, and potential changes to the class structure based on semester schedule constraints.

Key Words: Guidebook, Scheduling, Semester, Curriculum, Cal Poly

Introduction

The Commercial Construction Management lab (CM 313) is the third hands on lab that construction management students take at Cal Poly. It is offered the third year as it requires many prerequisites to be completed before the lab can be done. Half of the lab is comprised of group work assignments that challenge students to work together to complete a bid for a commercial job. The other half of the lab is the hands on portion where students work together in small groups to build wall sections. This class is currently run on a 10 week system and is soon going to be changed to a 15 week system as Cal Poly...
is transitioning to the semester calendar. This change brings on many challenges that will alter the
way all classes are run. CM 313 and other hands on labs bring an additional challenge with this
transition as they require the most time, space, and resources to complete. The transition challenges
was a main component for the creation of this senior project.

**Background**

The idea for this senior project generated from conversations with the current professor for CM 313
about improvements to the class as Cal Poly transitions to the semester system. The task of being the
instructional student assistant is challenging for those that undertake it because there is a lack of
proper training before the job is given. The information about how to build is given to the ISA the
same time as the students, so both students and ISA have the same knowledge. The only upper hand
that the ISA has is that they have completed the lab before, but there is no basis of knowing what
information had been retained from when it was taken. This experience led to the creation of the
builders guide. The need for this guide is crucial for the ISA’s to be able to assist students each week
with the building process without needing to relay questions back to the main professor. ISA’s should
be able to answer basic questions pertaining to the construction of the wall. The idea began as a
simple packet that would answer common questions. Through conversations with Joseph Clearly/
Instructor/Course champion, this morphed into more ways that this senior project could benefit the
CM 313 class as well as the Construction Management department.

Materials for the labs are purchased by the Simpson Strong Tie technician (SST technician). They are
provided with a list of materials with some quantities and expected to have everything ready for all
labs. Procurement is conducted at the beginning of each quarter. If there are missing materials
throughout the quarter the SST technician is notified and are required to buy new materials. The
current SST technician, Allison Wild, shared the difficulty of this job as the materials can be
challenging to find and are not easy recognizable from name alone. This led to the idea of the SST
technician material guide. This guide would be made to add more information to the materials list in
order for the SST technician to be able to easily order and find materials needed for the CM 313 lab.

Finally, as senior project potential discussions wrapped up, the conversation of Cal Poly transitioning
to the semester system came up and how the department was going to have to change a lot of classes
to fit this new system. There were several aspects of this transition that were challenging and having a
student perspective would be beneficial to the department. This was how the final piece of this senior
project came to be. It was concluded that this would be the most helpful component to the class as it
was actively being discussed by faculty and having an outside perspective could bring new ideas that
were not previously thought of to the table.

**Process**

Work for this project was able to begin the first week of the quarter due to the flexibility of the
project. The first step for this project was the SST technician material sheet. This was because it
would require the communication with the current SST technician as they were purchasing materials
for the current quarter. This process began with communication with the current SST technician
Allison Wild about her duties and what the process is like for procurement. The procurement for each
quarter is conducted at the beginning and it would be easiest to get this deliverable complete early on
in the quarter. Constant communication about materials, deadlines, quantities, and suppliers was had
to ensure the correct information was provided on the material sheet. The quarter began with the
ordering of larger materials from suppliers that would typically have longer lead times. This was to
ensure that the materials would be delivered to the lab before they were needed for construction.
During this time was when the supplier information and need by dates were procured for the material
Throughout the first two weeks as all materials were being ordered, was when the majority of this deliverable were acquired. Images of all materials were taken as they were delivered to campus. Some excess materials from previous quarters were reused for imaging as they are reused to prevent excess waste.

Close work with the current ISA, Rob Dasch, for Commercial Construction Management had to be done in order to coordinate each page of the builders guide. The ISA would send an email at the end of each build day with questions they were asked pertaining to that days work. This also included items they thought should be included that would help out future ISA’s. Images were taken of each step of the process in order to be incorporated into the builders guide. This would give a visual to future ISA’s as to what the end product for each day should look like. Figure 1A and Figure 1B are examples of the type of images that are included in each weeks page. There are typically three different shapes of walls that are built. This adds a challenge to the ISAs as there are a three different specs that they must know for different groups. This was something that needed to be included into each step of the builders guide leading to different images for each step of the different walls. Measurements for required components are included to make sure there is a sense of similarity between walls. This includes minimum width and length for foundation to be able to properly support CMU wall. The window dimensions are different for each wall shape and therefore are included into the metal framing page along with drawings to help as a visual aid. Communication with the professors that run the lab was important to collect information about proper procedures, dimensions, and materials will be utilized. The builders guide could not be complete without proper approval from the supervising professors.

A second part of this ISA guidebook was the creation of the pre-task plan and a post-task report model. Two important assignments that are apart of the lab are the pre and post task reports. Students are required to prepare documents before the build and after the building portion of the lab. The pre task plan consists of an introductory paragraph into what the project is, trades and materials highlighting what will be used, means and methods for how things are going to be done, along with risks and challenges. This stretches students learning to think about what they might have to do during the construction process. The post task report is completed after the building is finished. This is comprised of the same four categories along with actual pictures of each step of the process. This task was completed by going through old versions of submissions along with the rubric to create a thorough and complete sample that can be used for examples in the course. This is going to benefit the students by giving them a visual of what their reports could look like.

The creation of the semester conversion analysis report was the last item completed. This was due to the nature of the rest of the deliverables being completed as they were being done in real time. The location of a new strong frame was the first item completed. This was done through walking the area
surrounding the current Construction Management building to get a feel for potential locations. Then
the use of software such as Google Maps and Bluebeam were utilized to create images of suggested
locations compared to the existing strong frame. Scheduling was next, and this process had to be more
creative as this was something that was more challenging and less visual. Multiple iterations of
schedules were created that were potentials for the semester conversion. Some of the suggestions
included in the proposal were not feasible, however they are still included in the report as they
provide helpful insight from student perspective. The last part of the proposal that was created was the
suggestions. Information for this section came from all parties that assisted with this senior project.
Communication between all parties was documented and key components were included as
suggestions for the betterment of the class.

Deliverables

This project was comprised of three total deliverables, each created to benefit the future of CM 313 in
a different way. A builders guide to supplement the instructions for the building portion of the lab, an
SST technician materials guide, and an analysis proposal for the transition into the semester system.
Each deliverable was designed to benefit the CM 313 lab in a different way by being useful to
different users. The builders guide ultimately benefits the Instructional Student Assistants (ISA’s) by
providing greater detail into the actual construction portion of the lab. With their increased
knowledge, they are able to assist students better during lab time ultimately benefiting the professor
and students of the class. The guidebook could potentially be used by any new professors that are
hired onto the department to take on the role of a CM 313 professor. This would be an initial
introduction to the building portion of the lab and could be a useful starting point. The SST technician
materials guide benefits the SST technician by providing more information about what materials they
need to order for the CM 313 class. It consists of quantities, images, due dates, location of purchase,
etc. This information is vital to the technician so they are able to purchase the right materials and have
it delivered on site at the right time. This also benefits the entire construction management department
by having a fully stocked SST with the right materials that can be utilized by all classes. The analysis
report for the transition into the semester system benefits the construction management department
and any future students.

The SST technician materials guide is a two part deliverable that includes information for each step of
the construction process as well as all fasteners, saw blade types, and miscellaneous items. The guide
includes item name, size, quantity, supplier, need on site date, and image references. These are all
items suggested to be incorporated by the active SST technician. The images was the most important
part especially for the fasteners, as the most challenging aspect of the job was identifying the right
materials. Figure 2 shows the technician sheet excerpt pulled from the CMU wall section. The sheet is
broken out into each phase of the construction process to make procurement easier for the technician.
The quantities are broken out into quantities per group, number of groups, and totals. This allows for
easy changes to be made that will update on the spreadsheet. The formulas are inserted into the sheet
to allow for easy changes. The allocation of materials per building allows for items to be ordered
together including a need by date for onsite delivery. An inclusion of material data sheets, safety data
sheets, and live links are also available for all items that require them. This allows for more detailed
information to be included in the reference for all who use the guide. This is a live document that is
intended to be updated with new information as it is released. Some materials require new suppliers to
be found this is noted in the sheet and should be updated when a new supplier is selected. This would
require the update for links as well when they are found. Safety data sheets are included from
suppliers and links are incorporated where applicable.
Figure 2. Excerpt from SST Technician Guide

The builders guide is an eleven page booklet comprised of information on each step of the building process. Materials are listed as well as process steps for each phase. Notes and images are included where necessary to enhance the knowledge provided. This document is intended to be updated as the building process evolves throughout the courses lifetime. This document can be updated by different ISA’s as they learn useful tips that could help the next in line. As can be seen in figure 3, an important

Waterproofing - Siding - Trim

Materials
- OSB
- Wood to metal fasteners
- Tyvek House Wrap
- Staple Gun
- Trim
- Fiber Cement Siding

Process
Cut and attach OSB to front facing wall.
- Tyvek House wrap is then used to cover OSB. Using staples to attach.
- Trim is cut and placed around window and on corners of wall.
- Fiber cement siding is then placed on top of Tyvek starting from bottom of wall. Overlap for siding should be ___

Window Trim
House wrap should be cut so that paper can be wrapped inward and taped to studs.
Trim should be placed so that water cannot infiltrate interior.

Figure 3. Page from Builders Guide
note included was about the window trim. This is a common mistake groups make during this phase of the construction process. There are two options for window trim that can be done to prevent water infiltration inside the building and these options are present on this sheet. There is also a rough schedule included for the building process that incorporates each week with what should be worked on for each of the build days. There is a page for what the ISA should keep an eye out for regarding the students building techniques. The last page is regarding safety to include some simple reminders to the ISA to keep an eye out for everyone’s safety on the site during construction.

The analysis proposal consists of three parts. The first being the suggested location for a future strong frame. As the structure of the course changes, there needs to be a third section added each semester. This requires more building space that is not currently available in the department. This report includes multiple location suggestions as well as write ups for each including reasoning and suggestions. The second part of this proposal pertains to the scheduling of this additional section. In figure 6, you can see the inclusion of the red section at night. This is one of the four suggested options for scheduling. The third part of this proposal is the suggestions for the changes to be made to the class as a whole. This includes staffing recommendations, group size changes, material procurement, and additional ISA recommendations. This final section of the analysis proposal can be valuable to the department to have honest student input on the changes they suggest.

Figure 4. Suggested Location of New Strong Frame

The report was created originally during the duration of the quarter as real discussions were being had by the department. Real decisions were made after the report had been created and information had to be included after the report was completed. These changes are noted within the report to allow the
reader to know what was originally suggested for the project and what some actual decisions were that were made by the department. Even though some of the suggestions in the original report might not be feasible for actual use by the department, they are still valuable to the learning for this senior project as well as to the department. Figure 5. shows an example of the every other day suggested schedule created by the department that is being proposed to Cal Poly. This comes from the actual proposal which entails the need for class meetings twice a week for 15 weeks rather than four times a week for 10.

**Lessons Learned**

This project demonstrated the challenges of sticking to deadlines that are not obviously set. Being able to complete work on one's own timeframe is a skill that was achieved throughout this process. Falling behind is very easy to do in senior project because of how relaxed it can feel at times. The pressure really builds during the second half of the quarter and it can be difficult to get on track. Making sure to communicate with your SME is crucial to make sure that visions line up regarding final deliverables. You do not want to get caught up creating something that does not match the expectations.

The completion of this project was rewarding because of ability for the deliverables to be used by the department. This provides an opportunity to better the CM 313 class and make work a little easier for those in it. As a project based project without building something it could feel as if the deliverables were not worth sharing. One of the deliverables has already been used for the training of the new SST.
It is validating to know that the items created for this senior project are already being used as they were intended and well received. A lot of work went into the creation of three separate deliverables that were intended to benefit the future of the CM 313 lab and the Construction Management department moving forward.

Conclusions

To conclude, the recipient of the deliverables was satisfied with the work and one of the sections of this senior project is already in use. The new SST technician is being trained to take over the position for next year and during the training they got to learn about and use the SST technician materials guide. They mentioned that it was going to be very helpful and that they were glad that it was a tool that they could utilize for the upcoming school year. This project was a first step to making life a little easier for those working with the CM 313 Commercial Construction lab. There is still a lot of work to do to transition the Construction Management Department into the semester schedule which will provide a lot of opportunities for future senior projects.

Future Work

Future work based on this project could result in the expansion of the builders guide as the commercial class evolves. If there are any changes made to the current building process then the guidebook will need to be updated and changed. This would require students to evaluate the current guidebook and alter any methods, materials, and/or images currently present. This project could also influence the creation of a guidebook for the residential construction lab at Cal Poly and/or any other lab that uses hands on practical construction learning. This would benefit any future professors that are hired on to teach different labs and all ISAs that are hired on to assist.

Another example of future work that would stem from this project would be the expansion of the SST technician document. This project was conducted to assist with the purchase of the materials required for CM 313 (Commercial Construction Management). There are opportunities for the creation of an SST technician document for all other materials required for the construction management department at Cal Poly. The SST technician is already in charge of purchasing all materials for the construction management department and they are provided with lists of materials required for each class, however they are not always easy to understand and leads to confusion and the purchase of incorrect materials. The benefit of this future research would be to the entire construction management department because the SST technician will be able to more easily purchase materials required and have them delivered on time. The staff will have fully stocked materials for their respective classes and will not have to constantly notify each new SST technician of what they need. The students will benefit by having the proper materials on build days so they do not have to make do with the scrap materials that they have.

Finally, the proposal for the transition to semester systems is a project that could be carried out for any class for the Construction Management Department. There are some classes that are going to need to be cut completely and other classes that will most likely be combined. These decisions are ultimately up to the department and Cal Poly, but student input is valid and can have a great impact on future students. As the people who take the classes, students are the most aware of what works well and what does not. Having students analyze the current state of classes and provide recommendations for how it should change in the future can be very beneficial as the department receives real honest feedback on the classes provided. This research would give the department an idea of how students respond to the current curriculum and would provide insight into how they believe the courses should change to better the department for future students and staff.