

Developing a Scheduling Module For Construction Management Labs

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The Cal Poly Construction Management Department is renowned as one of the best programs in the nation. From holding one of the highest competition success rates to almost 100% job placement right out of school for graduates, Cal Poly undoubtedly lives up to that reputation. With that, in order to ensure that the department continues to produce well rounded graduates, it is crucial to regularly assess any potential shortcomings that the construction management curriculum may possess. As one of the three sides of the construction management triangle, the ability to read and create a construction schedule is a crucial skill for any project engineer or manager to possess. There is a broad spectrum of elements that go into creating a project schedule: from the programs, to the sequencing, to the overall logistics. This topic is something that is lacking in the current curriculum. This construction scheduling module would add to the overall Cal Poly Construction Management degree as well as benefit the graduates for the entirety of their careers.

Key Words: Master Schedules, Scheduling Courses, Primavera, Construction Education

Introduction

The primary goal of this project is to create a more well rounded course curriculum for the students that will capture all of the responsibilities that we will face in the field during our internships and post grad. It is safe to say that I have quite a bit more scheduling experience than my peers, all of which can be attributed to my position as a scheduler for the ASC commercial competition team, as well as through various internships where I requested to shadow my superintendents and scheduling consultants. However, most of my scheduling knowledge was self taught, supplemented by various industry contacts. Due to the lack of the current scheduling requirements being met in construction management labs, demonstrated in Cory Babinski's *Investigating the Cal Poly Computer Scheduling Curriculum*, I worked extensively on creating a module for the industry specific construction management labs that will require students to individually pursue new knowledge in scheduling.

Methodology

In order to properly structure the deliverable for this project, it was important to understand the needs of the students as well as the professors. Additionally, I needed to gauge what was being taught in each lab in regards to scheduling, since quite a few of the labs have come under new 'management' since I had taken them. In order to begin with my first objective, I researched previous students senior projects to determine if there had been any investigation regarding scheduling or implementing a scheduling topics course. In winter 2016, Cory Babinski completed his senior project titled *Investigating the Cal Poly Computer Scheduling Curriculum* which, as mentioned above, assessed the current curriculum standards in regards to scheduling. From his research, Babinski concluded that the overall effectiveness of the department's teaching of scheduling and scheduling programs is subpar. In addition, there was a student desire for a more in depth knowledge of scheduling, be it through more content in labs or a new technical elective revolved around project sequencing and scheduling software. From there, I interviewed several professors who teach these core labs to establish a set of standards and takeaways that each professor expected from his/her students. The following is a summary of these goals/standards:

- Students gain the ability to understand sequencing of a construction project
- Students gain the ability to comprehend a construction schedule
- Students gain the ability to create a construction schedule with logical activity ties and durations

From here, I worked with current CM 313 professor as well as the subject matter expert for this project, Andrew Kline, to create a module for his course that could be easily implemented and equally as successful.

Deliverables

Class Type

For the sake of this project, the following course module is designed for the commercial construction course (CM 313) of 15-25 students. Ideally this module will be molded to each of the industry specific labs (CM 214, CM 313 and CM 314) to enable students to fully understand the sequencing and scheduling of a variety of construction projects. In order to ensure that students regularly practice these scheduling techniques, weekly deliverables will be required from each individual student pertaining to a certain phase in the project, from preconstruction to structure to commissioning and all activities in between.

Lecture Content

In order to familiarize students with the scheduling programs, the first week of classes will consist of two, two hour sessions in the main computer lab where students will engage with the Primavera P6 scheduling software. There will be a rough schedule deliverable due at the end of each session to ensure there is student participation during these periods. The follow week will focus on basic project sequencing techniques as well as the logical flow of a typical construction project.

The subsequent scheduling lectures are meant to be given prior to that weeks scheduling exercise (see below for weekly content/exercise schedule). The weekly scheduling lectures will follow the sequence in which a building is built, as will the exercises. Each lecture subject is a typical project milestone, this break down will allow for students to focus on the individual content of the weekly lecture as opposed to trying to process an entire schedule at once.

Week	Content
Week 1	Introduction to Scheduling
Week 2	Sequencing and Linking Tasks
Week 3	Preconstruction Activities
Week 4	Mobilization/Make Ready Work
Week 5	Structure (Steel, Concrete, etc.)
Week 6	Interior Build Out
Week 7	Skin
Week 8	Commissioning
Week 9	Project Close Out

Exercises

Each exercise has been created from a real life project, in this instance the project is the construction of the UC Irvine Mesa Court Dorms. This is a 26 month total design and construction duration schedule, built by Hensel Phelps in 2016. The students will be given the construction documents at the beginning of the quarter as a supplement for their schedules.

A typical weekly exercise supplies the students with the maximum working days for several major preconstruction or construction activities but nothing more. These activities will require the students to research what tasks are appropriate to go under 'Site Work' or 'Structure' and then link those tasks to complete the portion of that exercise. Refer to the 'Notes/Other' tab for all exercises.

The ultimate goal with these exercises is for students to have a comprehensive schedule for a commercial building complete with relevant tasks and activity ties complete by the end of the quarter.

Lessons Learned

Through sitting in on some CM 313 classes and observing the students, there is definitely a gap in our curriculum when it comes to preparing students in regards to all things scheduling. However, professors like Andrew Kline are making huge strides to change that. Unfortunately, I learned that not all faculty are as receptive to this idea nor do they see a need for an addition like this module to their labs. It is this attitude that will continue to halt the future progress of this module from entering into all of the industry specific labs.


As for the individual exercises, I found that just because I could complete one of these exercises with ease, does not mean that others can. I realized that scheduling is an extremely important aspect of scheduling, but it is not always everyone's priority when it comes to their education here. I do hope that through this module, student will gain at least some of the same admiration for scheduling that I have.

From my overall experience with this project I have learned a couple of things, this first being: do not procrastinate until the end of the quarter. It is very easy to say "Oh I still have weeks to do that," but then its week eight and you realize you present your project in seven days. Fortunately, I chose a topic I was very interested in and I had an SME who actually had a vested interest in my project as well. With that, my other lesson learned is to take advantage of your SME. These people are here to help you, so let them. If I can give any advice to future senior project students, find an SME who is truly passionate about your topic, not just one who will pass you regardless of your work. This project is supposed to be something that teaches but also challenges you, and so should your SME.

References

Babinski, Cory. *Investigating the Cal Poly Computer Scheduling Curriculum*, Winter 2016.

Iroz, James M. *Lean Scheduling: Teaching Module*, Fall 2017

	<p>COLLEGE OF ARCHITECTURE & ENVIRONMENTAL DESIGN CONSTRUCTION MANAGEMENT DEPARTMENT CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT ANDREW KLINE - LECTURER CONSTRUCTION SCHEDULE - PRECONSTRUCTION</p>
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ASSIGNMENT:

- Create a comprehensive ‘Preconstruction Schedule’ for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule “flows” well.

DELIVERABLES:

1. Preconstruction:
 - a. Design - The design package must be approved before that scope of work can begin.
 - b. Design packages are often used to allow construction to begin while the design is being completed. Don’t forget design development drawings must occur before design packages for construction can begin. Design packages #3, #4 & #5 cannot begin until #1 and #2 are complete.
 - i. Design Package 1 – Demo & Site Utilities (34 WD)
 - ii. Design Package 2 – Structure (65 WD)
 - iii. Design Package 3 – Skin (100 WD)
 - iv. Design Package 4 – MEP and Finishes (115 WD)
 - v. Design Package 5 – Site Finishes (80 WD)
 - c. Procurement (245 WD)
 - i. It is imperative for project success to capture and track all long lead item procurement for MCEP.
 - ii. Activities should encompass all scopes required to execute the job.
 1. Elevators (80 WD)
 2. Mechanical (60 WD)
 3. Electrical Systems (80 WD)
 4. Glazing/Skin (140 WD)
 5. Kitchen Equipment (70 WD)

DUE DATE: See Polylearn

	<p>COLLEGE OF ARCHITECTURE & ENVIRONMENTAL DESIGN CONSTRUCTION MANAGEMENT DEPARTMENT CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT ANDREW KLINE - LECTURER CONSTRUCTION SCHEDULE - MOBILIZATION AND MAKE READY</p>
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ASSIGNMENT:

- Create a comprehensive ‘Mobilization and Make Ready Schedule’ for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule “flows” well.

DELIVERABLES:

1. Construction
 - a. Demolition / Excavation (85 WD)
 - i. MCEP requires existing structures to be demolished and site cleared prior
 - b. to construction.
 - i. Activities should show a clear sequence of demolition the team proposes.
 - c. Site Utilities (100 WD)
 - i. Provide enough activities to demonstrate all utilities installed to support MCEP.
 - d. Site Work (155 WD)

DUE DATE: See Polylearn

	<p>COLLEGE OF ARCHITECTURE & ENVIRONMENTAL DESIGN CONSTRUCTION MANAGEMENT DEPARTMENT CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT ANDREW KLINE - LECTURER CONSTRUCTION SCHEDULE - STRUCTURE</p>
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ASSIGNMENT:

- Create a comprehensive ‘Structure Schedule’ for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule “flows” well.

DELIVERABLES:

2. Construction
 - a. Structure – There are only (2) sets of wall forms and (2) sets of deck forms.
 - i. Basement (60 WD)
 - ii. Main Podium (94 WD)
 - iii. South Podium (93 WD)
 - iv. North Tower (101 WD)
 - v. Center Tower (104 WD)
 - vi. South Tower (104WD)

DUE DATE: See Polylearn



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CONSTRUCTION MANAGEMENT DEPARTMENT

CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT
LECTURER

ANDREW KLINE -

CONSTRUCTION SCHEDULE - INTERIOR BUILD OUT

ASSIGNMENT:

- Create a comprehensive 'Interior Build Out Schedule' for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule "flows" well.

DELIVERABLES:

3. Construction
 - a. Rough Ins
 - i. Basement (125 WD)
 - ii. Main Podium (105 WD)
 - iii. South Podium (80 WD)
 - iv. North Tower (125 WD)
 - v. Center Tower (125 WD)
 - vi. South Tower (125 WD)
 - b. Elevator (130 WD)
 - c. Finishes
 - i. Main Podium / Kitchen (130 WD)
 - ii. South Podium (130 WD)
 - iii. North Tower (65 WD)
 - iv. Center Tower (65 WD)
 - v. South Tower (65 WD)

DUE DATE: See Polylearn



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LECTURER

ANDREW KLINE -

CONSTRUCTION SCHEDULE - EXTERIOR AND SKIN


ASSIGNMENT:

- Create a comprehensive 'Exterior/Skin Schedule' for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule "flows" well.

DELIVERABLES:

4. Construction
 - a. Exterior & Skin
 - i. Main Podium (60 WD)
 - ii. South Podium (60 WD)
 - iii. North Tower (114 WD)
 - iv. Center Tower (100 WD)
 - v. South Tower (100 WD)

DUE DATE: See Polylearn

	<p>COLLEGE OF ARCHITECTURE & ENVIRONMENTAL DESIGN CONSTRUCTION MANAGEMENT DEPARTMENT CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT ANDREW KLINE - LECTURER CONSTRUCTION SCHEDULE - COMMISSIONING</p>
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ASSIGNMENT:

- Create a comprehensive ‘Commissioning Schedule’ for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule “flows” well.

DELIVERABLES:

5. Construction
 - a. Commissioning (109 WD)
 - i. Activities to assist in the Equipment Testing & Commissioning schedule buildout:
 1. Final Equipment Connections/Terminations
 2. Test and Balance Air
 3. Space Complete Buildout
 4. Owner Functional Testing & Sign-Off
 5. Fire Marshal Testing & Inspection
 6. Energize Equipment
 7. Program System
 8. Pre-functional Testing
 9. Fire Marshal Final Inspection & Sign-off
 10. Equipment & Installation Code Inspections

DUE DATE: See Polylearn

	COLLEGE OF ARCHITECTURE & ENVIRONMENTAL DESIGN CONSTRUCTION MANAGEMENT DEPARTMENT
	CM 313 – COMMERCIAL CONSTRUCTION MANAGEMENT ANDREW KLINE - LECTURER CONSTRUCTION SCHEDULE - PROJECT CLOSE OUT

ASSIGNMENT:

- Create a comprehensive ‘Project Close Out Schedule’ for the UC Irvine Mesa Court Expansion using the construction documents on Polylearn and the information provided below.
- There should be a continuous logic flow of critical path activities from Notice to Proceed, Design, Fabrication and Delivery Lead Times, Structure, Rough-In, Finishes, Punchlist and Commissioning.
 - Organize your activities so they are easy to read, are grouped intuitively, and the schedule “flows” well.
- Substantial Completion is defined as “the building can be used for its intended purpose.” In order to satisfy this requirement, all construction activities shall be substantially complete, the building systems must be operational and all code required inspections must be complete including State Fire Marshal Sign Off.

DELIVERABLES:

6. Construction
 - a. Punchlist
 - i. Basement (20 WD)
 - ii. Main Podium (30 WD)
 - iii. South Podium (20 WD)
 - iv. North Tower (60 WD)
 - v. Center Tower (60 WD)
 - vi. South Tower (60 WD)

DUE DATE: See Polylearn