



Environmental Studies Lab: Expansion

East Coast, USA

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Executive Summary

The goal for this whole proposal is schedule acceleration. The first analysis focuses on an alternative delivery method. The delivery method researched in this analysis is design build. The main push would be to get the general contractor involved early which would help accelerate the schedule. It is expected that this analysis will be more efficient than the current delivery method. Not only will it improve the schedule, but it will improve the coordination and communication between the parties.

The second analysis is a short interval production schedule (SIPS). This analysis should also accelerate the schedule since it can be applied in the 18 large labs. When combined with prefabrication of the overhead MEP work, it can shorten the schedule as well as reduce waste. This analysis will also investigate the interstitial space. This will make renovations and rearrangements of the space below the interstitial space or the interstitial space itself simpler in the future.

A façade study will be performed for the third analysis. The purpose of this study is also to accelerate the schedule but also add value engineering to the project. By researching different materials, there could be fewer subcontractors and fewer materials. This would save money on the project. However, the most important thing is to not compromise the architect's objective. This analysis will bring about the opportunity for an architectural breadth and a mechanical breadth. The architectural breadth would be using the new materials on the façade. The mechanical breadth could be to ensure that condensation is not present in the wall while also making sure the R-value has not been affected in a negative way.

The final analysis is on the implementation of building information modeling (BIM). Since BIM was not really used on this project, I will explore how it may improve the project and the schedule. This analysis also includes the critical industry issue of facility management. The expected outcome for this is to prove how a BIM based facility management would be helpful. The facility manager should be trained and educated on how to maintain a piece of equipment. This analysis will include guidelines on how to perform this.

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Analysis 1 – Alternative Delivery Method

Problem Identification

The current delivery method, design bid build, is not the ideal delivery method. With this delivery method, coordination and communication were not handled in the best manner that they could have been. The schedule was also delayed on this project. With a different delivery method, this all could have been prevented.

Background Research

With design bid build, there are a few problems that could be solved with a different delivery method. Design bid build goes through each phase which means you cannot start one phase without finishing the previous one. There are multiple contacts in this delivery method. The owner acts a mediator for the contractor and the architect which can slow down the schedule. Another thing that slows down the process is that the owner has to find each company. When the owner does find these parties, they usually do not have any association with each other until the bid. This could hinder coordination and communication on the project since the architect and contractors do not have as close of a relationship as they could.

A better delivery method would be design build. The general contractor and the designer are in a joint venture. This means both of these parties will be in the same unit making it easier to communicate with everybody. The general contractor is also involved earlier in the project. They can assist with the design phase by foreseeing any problems that may arise. It helps accelerate the schedule because it is faster than design bid build. This method eliminates the bidding process. It also is faster because the project can be started without the design fully finished. Design build is a more cost effective method than design bid build because the designers have access to the construction cost as the project moves along. This could open up the possibility for value engineering.

Research Goal

Changing the delivery method may improve on certain aspects of the construction process. One of the main pushes here would be to get the general contractor involved early in the project.

1. Since the architect and contractor are both involved in the design phase, there will be more coordination at the beginning of the project and throughout the project.
 - a. The contractor will be able to determine if there would be an issue with the construction before it happens.

- b. This would mean they could fix the issue without compromising the architect's intention.
2. By changing the delivery method to design bid build, the schedule will be affected as well.
 - a. The schedule should accelerate considering construction can start when the design is not yet complete.
 - b. Since there will be coordination in the design phase, there should be less conflicts and problems out in the field during construction which will help accelerate the schedule.
3. This research may demonstrate that the current delivery method is the best method for this type of project.

Solution Method

- Research information from previous projects with similar aspects
- Gather information and results of surveys conducted by the AE department
 - Compare the different delivery methods on different projects
 - Compare the different delivery methods by Hensel Phelps
- Analyze the difference between getting the general contractor in early verses coming in after the design is complete
- Recreate a schedule with an alternative delivery method
- Determine which method is best for this project

Resources

Dr. Rob Leicht
Bryan Franz
Hensel Phelps employees and literature

Expected Outcome

It is expected that this research will prove that an alternative delivery method will be more efficient than the current delivery method. This includes schedule acceleration which has been a big issue on the Environmental Studies Lab: Expansion. With this research, Hensel Phelps may also be able to determine what delivery method they are most productive with. This analysis is also expected to prove that an alternative delivery method will improve coordination and communication on this project which will also prevent schedule delay.

Analysis 2 – Short Interval Production Schedule (SIPS)

Problem Identification

Since SIPS helps with efficiency, this will accelerate the schedule. There are 18 large labs in the Environmental Studies Lab: Expansion. These labs have the same layout and items in it. There are a few different options on which trades could have a SIPS. The casework trade, the finishes trades, or the MEP trades are all options for those labs. The MEP overhead rough-in would be very useful to have a SIPS. There is also an opportunity for prefabrication in an interstitial space as well in this analysis.

Background Research

The goal for this analysis is to accelerate the schedule through SIPS. SIPS is a very detailed form of scheduling that helps with efficiency out in the field. Each activity is assigned a duration that may be so precise it is down to the minute. It is critical to have good communication between all parties involved to avoid delays throughout each activity. Initially, there is a learning curve on the process. This will be there until the field workers familiarize themselves with the process.

There are 18 large labs in the Environmental Studies Lab: Expansion. Since they are all the same layout, there is an opportunity to use SIPS. There is also the chance of prefabrication of the mechanical ductwork. The prefabrication would take place offsite leaving room for other work to be completed. Prefabrication also eliminates material waste which contributes to LEED. This prefabricated ductwork could go in an interstitial space.

Research Goals

1. The main goal for this analysis schedule acceleration
 - a. Even though there is a learning curve at the beginning, once the crews get accustomed to the process, this portion of the project will speed up
2. Prefabrication is also an option that will accelerate the schedule when combined with SIPS
 - a. The overhead ductwork can be prefabricated into modular units
3. There is also enough ceiling space for an interstitial space.
 - a. This makes enough room for access to the MEP equipment overhead
 - b. This space also allows for future renovations and rearrangements

Solution Method

- Gather a better understanding of the SIPS method
- Develop a sequence of work for very specific tasks
- Create a SIPS in order to see how much the schedule could be reduced
- Analyze how SIPS could be improved with prefabrication in an interstitial space

Expected Outcome

It is expected that this analysis will help accelerate the schedule through the use of SIPS. By creating a SIPS, the construction of the 18 large labs will be faster than what was installed. If prefabrication is performed offsite, this could also speed up the schedule. An interstitial space would provide for easier future renovations or rearrangements. This could be to either the lab space below the interstitial space, or the overhead MEP in the interstitial space. All of this is expected to accelerate the schedule.

Analysis 3 – Façade Study

Problem Identification

The façade is very intricate with many different materials. These different materials mean multiple subcontractors and with multiple subcontractors, there are more contracts and more people to coordinate with. The different trades would be stacked on each other which could hinder productivity and quality. There are also a few materials that are very expensive. However, the architect's intentions with this façade should not be compromised.

Background Research

The main façade materials are: brick veneer, corrugated metal panels, composite metal panels, fiber cement siding, and a curtain wall system. Between the façade and the whole exterior skin, there are 47 different materials. By performing this analysis, there will be an architectural breadth and a mechanical breadth (see Appendix A).

Research Goal

1. Using different materials may improve on a few different aspects of the façade.
 - a. This material may be more cost effective
 - b. The different materials might be easier to install resulting in a faster completion time.
2. Another possibility would be to use fewer materials that are more similar in composition.
 - a. This could mean fewer subcontractors.
 - b. With fewer subcontractors could result in fewer problems with coordination.
3. This analysis may also result in a schedule acceleration due to the previous solutions mentioned
4. However, this study could also prove that the current façade is the best façade there could be while still keeping the architects intentions.

Solution Method

- Contact the architect in order to determine what their intent was for the façade
- Research different materials that still meet the architects intentions
 - a. Research the function of the materials
- Consult with professors about the concerns with different types of facades
- Perform a square foot estimate to determine cost difference of new the façade verse the current façade
- Critique the study to determine if this alternate façade is an improvement over the current façade

Expected Outcome

It is believed that this façade study will result in a quicker, more cost efficient method than the current method implemented. By changing the materials, the cost of construction could be reduced and the schedule could possibly be reduced as well. There is also the possible outcome of using less material that would also result in a quicker turnover. However, the most important thing is to keep the architect's intent.

Analysis 4 – Building Information Modeling Implementation

Problem Identification

On the Environmental Studies Lab: Expansion, there was not a lot of Building Information Modeling (BIM) implementation. There were a few problems that could have been prevented if BIM was used. There was a big issue with coordination between subcontractors. BIM could have also been implemented at the end of the project for facilities management. Since this is a lab, there is a lot of complex equipment and processes that need to be maintained properly.

Background Research

BIM has many uses; it can be used for 3D coordination, site utilization planning and analysis, structural analysis, digital fabrication, and facilities management. Since a clash detection was not run, there were a lot of clashes between the MEP work. Most of the issues were between the duct work and the fire protection.

The main focus on this analysis will be on facility management. Since this is a research lab with complex lab equipment and MEP equipment, the facilities manager may need to be educated on some of the equipment. This was a critical industry issue at the PACE roundtable. BIM could easily assist the maintenance personal in locating and understanding how to proceed with the equipment that has an issue. This process could be very helpful in the long run to prevent costly measures to fix an issue.

Research Goals

1. 3D coordination would have solved the clashes before the construction even started.
2. Other aspects of construction or design could have been made easier
 - a. Site utilization plan could have been updated and changed to make sure materials and equipment would not be in each other's way.
 - b. Virtual mockups implemented to ensure the construction will be completed properly.
3. Easy turnover because of facilities management.
 - a. Complex lab equipment would be easier to maintain
 - b. MEP equipment would also be easier to maintain

Solution Method

- Consult with AE Personnel concerning facilities management
- Research BIM programs that would applicable to the Environmental Studies Lab: Expansion
 - Contact the owner and the project team to see if they have used any of these programs

- Interview owner and facility managers to understand their needs and experience with BIM or any asset management
- Determine the equipment that would be proper to use for a BIM facilities management analysis
- Create a guideline of how to successfully turn over a specific piece of equipment

Resources

Dr. Craig Dublar
Dr. Ed Gannon

Expected Outcome

The expected outcome for this analysis will make for an easier turnover for the facilities manager. Since there was not any BIM implemented for the facilities management, this analysis should state how it would be helpful. By creating guidelines for a particular piece of equipment, this analysis should assist the facility manager in maintaining that piece of equipment.

Critical Industry Issue

At the PACE Roundtable event, I attended the session “Efficient Delivery of Facility Management Information”. This discussion was about the efficient and inefficient aspects of the delivery of facility management information. One of the big issues with BIM facility management is the facility manager not being properly educated on how to use the BIM. BIM is easier than flipping through drawings, however this only holds true if it is used properly. The installer needs to train the facilities manager on how to maintain the equipment and the project team needs to train the facilities manager on how to use the BIM. This all takes time and needs to be accounted for. In order to manage this process properly, the facility manager should be involved early. I will conduct an interview with the owner and the project team concerning the facility manager and if they are involved and well informed. Since I am aware that there was not BIM facility management involved, I will make sure to identify the asset management goal.

See Appendix B for Interview questions.

Conclusion

The goal for all four of these analyses is to accelerate the schedule since it was delayed so much in the project. The research for these analyses should prove to better the schedule without compromising the quality of the work. Analysis 1 and 2 are directly related to speeding up the schedule. Analysis 3 and 4 are indirectly related to speeding up the schedule. By performing a façade study, I will be able to identify different and less materials that call for less time to install than what is currently there. If BIM is implemented more, the project will avoid clashes and therefore fewer delays. Facility management will help with after the project is over to maintain the equipment.

Table 1 shows the weight breakdown for spring semester per these analyses.

Description	Critical Industry Research	Value Engineering Analysis	Constructability Review	Schedule Acceleration	Total
Alternative Delivery Method	5	5	0	15	25
SIPS	0	0	10	15	25
Façade Study	0	10	10	10	30
BIM/Facility Management	15	0	0	5	20
Total	20	15	20	45	100

Table 1 Weight Matrix

Appendix A – Breadth Topics

Architectural Breadth

Per the façade study in analysis 3, an architectural breadth would be the most probable breadth to perform. Since changing the façade has so many construction benefits, the result will be shown and evaluated in this architectural breadth. I will look into blending the façade with the surrounding buildings and the environment. This will hopefully help eliminate the “wall” between the inside and the outside. There will be some sort of visual model to display what changes have been made.

Mechanical Breadth

Since there is a façade study changing the materials, a mechanical breadth would be appropriate. With this mechanical breadth, there is a possibility for a condensation analysis in the wall. This would show how much condensation would be behind the façade with these materials. I will use the IES Virtual Environment program to complete this analysis and determine vapor pressures through the surfaces of the wall. I will then be able to determine what measures need to be taken, if any, to prevent the buildup of condensation. Another analysis possible with this breadth is an R-value calculation. By changing the façade, it could affect the R-value in a negative way by making it a lower value.

Appendix B – Interview Questions

The following are questions to be asked in order to further develop analysis 4, BIM implementation:

1. What methods are used now for facility management?
2. What takes the most time to compile and handover?
3. What workflows would be of high value to define more clearly and make repeatable?
4. Is the facility manager involved yet?
5. Will the facility manager be trained for maintaining the equipment?
6. Does the facility manager have experience with 3D modeling or have they just been exposed to paper documents?

Appendix C – Spring Projected Timeline

