ARNE KVINNESLAND | CONSTRUCTION MANAGEMENT

Thesis Proposal

Army National Guard Readiness Center

Advisor: Chris Magent

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Executive Summary

The Army National Guard Readiness Center project is a joint headquarters office building that will provide a workplace for hundreds of military employees. The project is located in Arlington, VA and consists of a 250,000 square foot office building and a 435 space parking garage. Both structures are being built on a site with an existing Army National Guard office building and parking garage.

This project is currently under construction and the general contractor is using Building Information Modeling (BIM) as a tool during the coordination phase of the mechanical, electrical, plumbing, fire suppression, and structural systems. For the general contractor and many of the subcontractors on the project, this is the first BIM project they have been involved with. The project management team has faced numerous challenges with the incorporation of BIM into their coordination process.

Two of the research topics proposed in this document deal with Building Information Modeling. The first is a research topic dealing with BIM and project deliverables, specifically deliverables that benefit the owner. Many owners are unaware of the capabilities of Building Information Modeling and the benefits that they can reap by paying for and requiring BIM on their projects. My first analysis topic will consist of a series of interviews of current owners and contractors using BIM and comparing that with a comprehensive list of deliverables that BIM is capable of.

The second analysis is developing a BIM Implementation Plan for projects that can be established early on in the planning of a project. The BIM Execution Planning group has developed an implementation plan that will be presented to the general contractor of Army National Guard Readiness Center to receive feedback on how it would/would not have helped them prepare for BIM on their project. Also, I hope to gain suggestions from the general contractor as to what can be added to the Implementation Plan based on their in-field experience with BIM.

The final two analysis topics presented in this document will cover the breadth topics for my thesis requirements: electrical loads from a photovoltaic system and structural redesign of a soil retention system. With the photovoltaic analysis, I hope to reduce the Army National Guard's reliance on local power companies to supply this project with power and to increase energy efficiency of the project. The structural redesign of the soil retention system, currently in the form of a secant pile wall, will have major cost and schedule impacts. These will be the main focus of this final analysis.

Contents

Analysis Descriptions

Building Information Modeling and Project Deliverables

At the October 2009 PACE Conference, the topic of Building Information Modeling as it relates to owner deliverables was brought up. By listening to the industry representatives there, it became clear that owners and even some project management companies are unaware of the capabilities of BIM and how it relates to project deliverables. There are many advantages that BIM has for both the owner and the project manager. Currently, there is no industry "standard" when it comes to BIM, so identifying expected deliverables and results of paying for BIM on a project is difficult at times. Finding a way to standardize expected deliverables for the owner would provide owners with a list of benefits they would receive by paying for BIM on their projects and what they can expect to see at project completion that can help them in the everyday maintenance and upkeep of the building.

A step by step approach will be taken to complete this research:

1. Compile a list of all possible items that can be considered a project deliverable and state a reason why an owner or contractor would want to pay for and take advantage of each features,
2. Interview five large owners/developers/contractors who are considering using BIM on their projects or who are already seeing BIM use and find out what their expectations are with BIM and why they adopted it,
3. Compare the compiled list of possibilities to the list created by the owners via the interview process and see where the average owner stands and what they could be missing out on.

My expectations for this analysis are that most owners and contractors will provide a list of typical schedule and cost savings impacts as their primary reasons for adopting BIM on their projects. I expect to be able to come up with a list of items that owners/contractors will not mention as expected benefits of BIM that can be provided to owners and contractors very early on in a project so that these deliverables can be built into the contract. It is also important to identify any deliverables that the owner wants early on so that the contractor can plan to provide those items at the end of a project. If the contractor is unaware of what the owner wants it may be very expensive or practically impossible to provide those items late in a project.

BIM Implementation and Educating the Project Team

The most difficult part of successfully running BIM on a project is the start-up phase and laying the foundation of how BIM will work throughout the duration of the project. This planning phase needs to establish a set of guidelines and standards that the entire project team, including designers, project managers, and subcontractors, will need to follow and adhere to to successfully complete their goals. BIM is still relatively new in the industry, although it is gaining in popularity and more contractors and subcontractors are capable of BIM now than ever before. However, there is still a long way to go before BIM becomes an industry standard.

Many subcontractors do not have BIM capabilities and will struggle throughout the coordination process to keep up with their fellow subcontractors, possibly causing schedule issues since the original schedule would be created assuming full BIM capabilities. Requirements for these capabilities are now being built into contracts with the subcontractors when they initially bid the project. How does the project team handle a subcontractor who claims they are BIM capable and then is unable to carry their own weight during the coordination process? This was something the Army National Guard Readiness Center project team struggled with and after spending a summer as an intern on site working with BIM every day, it became apparent that this may be an issue throughout the industry.

The BIM Project Execution Planning group at Penn State has developed a guide to the steps that need to be taken to develop a BIM Implementation Plan on a project. I would like to present that Implementation Plan to the project management team at Army National Guard Readiness Center and get feedback about how it would/would not have helped them on that project. I would also like to see if there are other options and pieces of information that can be incorporated into the BIM Implementation Plan already established to improve its performance in-field.

The BIM Execution Planning group has done a great job of setting up baseline procedures for BIM Implementation. What I expect to see is for the project management team on Army National Guard to provide additional recommendations for the BIM Execution Plan taken from their in-field experience with BIM. This information can then be relayed to the BIM Execution Planning group to expand on their current research.

Photovoltaics and Energy Independence

The Army National Guard Readiness Center is a large headquarters building full of high end security and electronic systems requiring a large electrical load being supplied to the building. There are backup systems for the building in the form of diesel powered generators on the roof. However, this building is seeking a LEED Silver rating and is on the border of receiving a LEED Gold rating and diesel power is not gaining them any points. Incorporating a photovoltaic system to aid in the everyday powering of the building along with supplying a source of backup power that is more energy efficient and environmentally friendly than diesel powered generators would be a major benefit to the Army National Guard if it can be done for a worthwhile price. Minimizing energy dependence from the local power company is also a security benefit for a military facility such as this.

Replacing part of the curtain wall system in a location likely to provide the greatest return with photovoltaic panels may be a great benefit to the Army National Guard. This analysis will be completed as such:

1. Perform a solar sweep and energy intake analysis of the project to locate the façade location which will provide greatest returns for solar panels,
2. Pick a solar panel system and calculate possible returns from that system to identify how much power would be supplied to the building,
3. Run a brief cost analysis to see if the returns from the photovoltaic system outweigh the initial installation cost of the system.

I expect that the photovoltaic system will provide a decent energy return for the initial cost of the system. Becoming more energy independent and gaining possible LEED points for providing a more energy efficient system are both items that would interest the Army National Guard. The challenge would be incorporating the system in a way that does not negatively impact the aesthetic appearance of the building.

Secant Pile Wall Construction

The construction of the secant pile wall was a major challenge on the Army National Guard Readiness Center project. For most of the project team this was a system that they had never been involved with, so there was a learning curve associated with the planning and preparation for this system. Time needed to be allotted in the schedule for practice runs at drilling each of the different pile types, thus increasing the cost of construction. There were also numerous installation issues, from re-drilling piles to broken drill bits, this complicated system caused schedule problems and constructability issues throughout its entire installation. The schedule lagged and cost increased. The original schedule was already long due to the fact that it takes a long time to construct a secant pile wall retaining system.

The following steps will be taken during this analysis:

1. Perform research on why the secant pile wall was originally chosen over a different soil retention system,
2. Taking into account the results of the research stated in (1) above, identify a simpler soil retention system that can achieve the same goals as the secant pile wall system and run the structural calculations to prove equal performance,
3. Perform a cost and schedule analysis to show the overall time and money savings for the project due to a simpler installation process.

Unless there is an underlying reason as to why a more difficult and expensive system was chosen in the form of the secant pile wall, I fully expect to be able to find a replacement soil retention system that will save both time and money and perform at a similar standard as the secant pile system.

Conclusion

As a construction management student in the Architectural Engineering major, Building Information Modeling is a critical industry issue in my field. It is a tool that will continue to grow in popularity in the upcoming years and by focusing on two major BIM issues as analysis topics I have the chance to advance the research in this area.

The four (4) analysis topics that I will research next semester are as follows:

1. Building Information Modeling and Project Deliverables - a focus on deliverables that will benefit the owner upon project completion.
2. BIM Implementation and Educating the Project Team – research to further develop a BIM Implementation Plan for the Army National Guard Readiness Center as well as assist the BIM Execution Planning group in creating a BIM Implementation standard.
3. Photovoltaics and Energy Independence – a look at replacing part of the curtain wall system with a photovoltaic system to create a more energy efficient and energy independent building.
4. Secant Pile Wall Construction – a structural, cost, and schedule analysis of a replacement soil retention system for the current secant pile wall system.

Appendix 1 – Breadth Studies

Breadth One – Electrical

A solar sweep analysis and energy gain analysis for the building will be run to determine the best location on the curtain wall system to locate a photovoltaic system to maximize energy gains. Will include electrical calculations to determine total energy produced by the photovoltaic system and how much of the current system can be run on power generated by the photovoltaics.

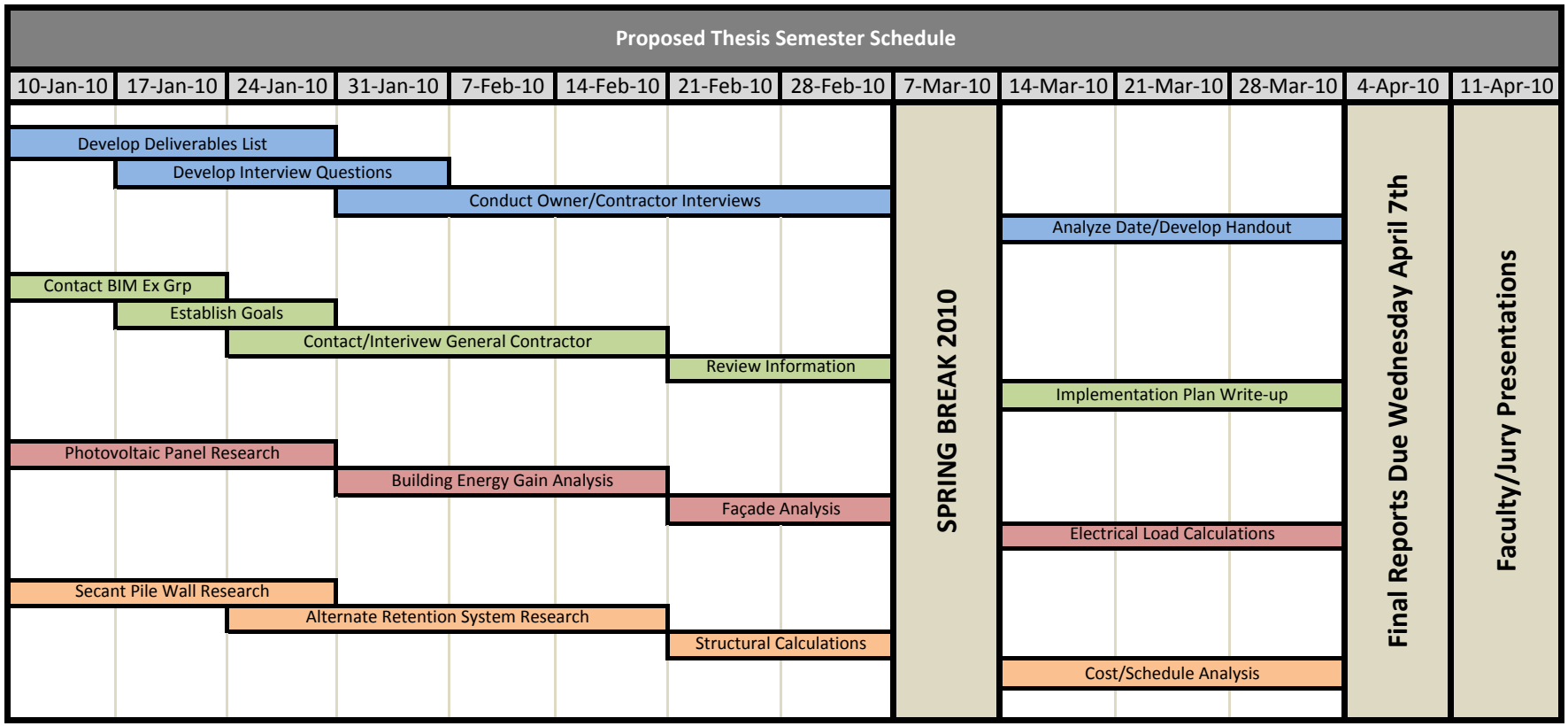
Breadth Two – Structural

Doing research to determine the reasons behind using the current secant pile wall soil retention system on the project followed by an analysis of other soil retention system options to replace the secant pile wall system. Will include structural calculations of the new systems to verify equal performance to the secant pile wall, as well as cost and schedule analysis due to a simplified system.

Appendix 2 – Weight Matrix

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Analysis 1	25%				25%
Analysis 2	15%			10%	25%
Analysis 3		15%			15%
Analysis 4		10%	10%	15%	35%
Total	40%	25%	10%	25%	**100%**

Appendix 3 – Time Schedule



Analysis #1 - Building Information Modeling and Project Deliverables

Analysis #2 - BIM Implementation and Educating the Project Team

Analysis #3 - Photovoltaics and Energy Independence

Analysis #4 - Secant Pile Wall Construction