ARNE KVINNESLAND | CONSTRUCTION MANAGEMENT

Thesis Proposal

Army National Guard Readiness Center

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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.

The first research topic proposed in this document deals with Building Information Modeling. It is a research topic dealing with BIM and project deliverables, specifically deliverables that benefit the owner once the project is complete. 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 final two analysis topics presented in this document will cover the breadth topics for my thesis requirements: design of a battery back-up and photovoltaic array system to replace the diesel powered generators incorporated into the building currently 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.

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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 by interviewing industry leaders and/or faculty members at Penn State who are actively involved with BIM research and state a reason why an owner or contractor would want to pay for and take advantage of each feature,
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/developers/contractors via the interview process and see where the each 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. The focus for this study will be placed on BIM deliverables dealing with the construction to operations transition and what can be used after a project has been completed by the owner and occupants of the building.

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 powered battery back-up 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.

This analysis will involve the development of the battery design and the photovoltaic panel array size needed to equal the capacity of the diesel powered generators. The analysis will be completed as such:

1. Research different options for batteries and photovoltaics that will be capable of achieving back-up power equal to that of the diesel generators,
2. Developing the battery design and photovoltaic panel array size needed to determine a location for the array,
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 battery/photovoltaic system will be able to achieve the same power output that the diesel generators can produce but the space needed for a system of this size may not be feasible for this project. Becoming more energy independent and gaining possible LEED points for providing a more energy efficient and environmentally friendly 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 a major BIM issue dealing with project turnover and deliverables I have the opportunity to advance research and the ability to educate owners and contractors in this area.

The three (3) 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. Photovoltaics and Energy Independence – a look at designing a battery back-up and photovoltaic array system to replace diesel powered generators currently incorporated into the building.
3. 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

Research will be done to select batteries and photovoltaic panels capable of producing power equivalent to a diesel generator. The battery and photovoltaic array size will be determined via load calculations by using the known power produced by the generators in the building. Finally, the cost implications of replacing this system will be analyzed to see if it is a feasible alternative for the owner.

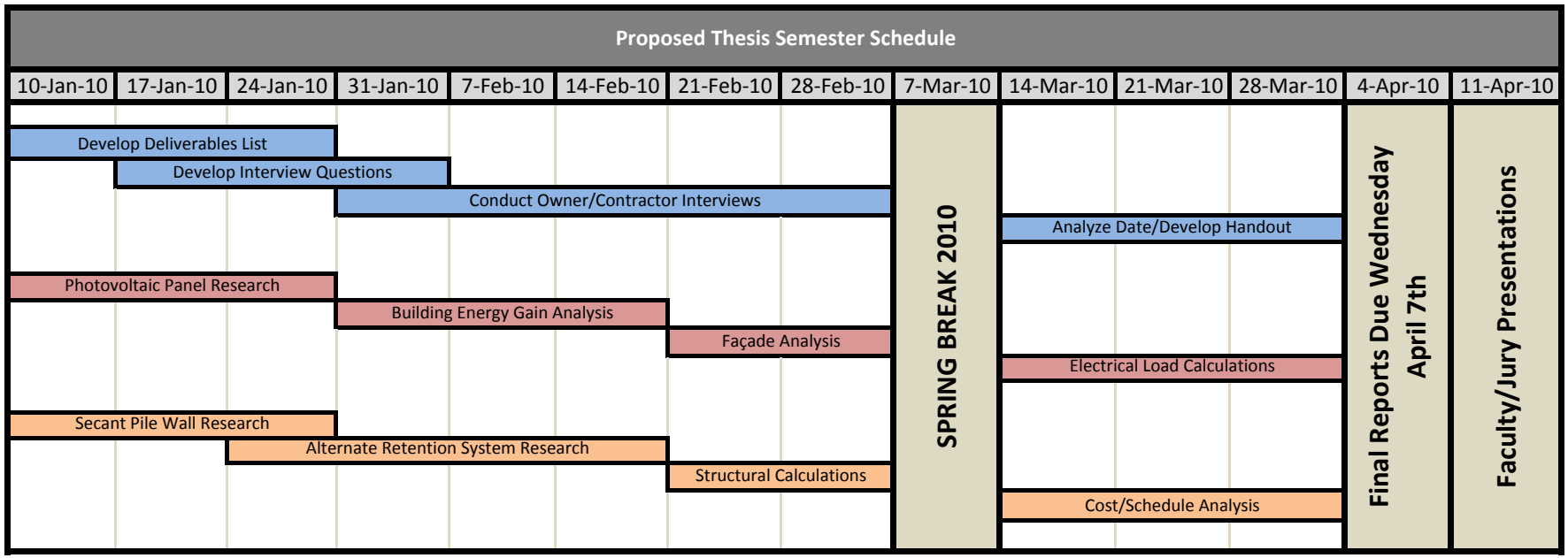
Breadth Two – Structural

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	40%				40%
Analysis 2		15%	10%		25%
Analysis 3		10%	10%	15%	35%
Total	40%	25%	20%	15%	**100%**

Appendix 3 – Time Schedule



Analysis #1 - Building Information Modeling and Project Deliverables

Analysis #2 - Photovoltaics and Energy Independence

Analysis #3 - Secant Pile Wall Construction