

Thesis Proposal

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CONSTRUCTION MANAGEMENT

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SCHOOL OF BUSINESS AND ENGINEERING**

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EXECUTIVE SUMMARY

The following proposal contains three topics that will be researched throughout the duration of the second semester of thesis coursework with respect to the Virginia Commonwealth School of Business and Engineering. The purpose of this research is to provide and examine alternative methods to modify the cost, schedule, and constructability of the building. In addition, the results will promote any value-engineering ideas that arise throughout the performance of this research.

After discussing the problems that transpired throughout the construction of the VCU School of Business and Engineering, I have decided to dedicate my research to the following three topics, which include a structural and mechanical breadth, and are presented below:

- **Analysis I**

The first analysis, which includes a structural breadth, will review the foundation system of the structure. This analysis will provide information regarding the cost and constructability of the original pile system, to that of the constructed deep foundation system. Through the completion of this analysis, my goal is to design a pile foundation system that not only meets the loading and bearing requirements, but one that also reduces the overall cost and time impacts that the deep foundations incurred.

- **Analysis II**

The second breadth topic will assess the mechanical system of the building. The system was designed as rooftop mechanical system. I would like to evaluate the rooftop units and explore alternate energy sources or ways to conserve energy for this building and make it more efficient. It may also be an option to do a cost-comparison and constructability review of building an additional floor for the mechanical system, which could also reflect potential value engineering opportunities. While I recognize that this statement is very indistinct, I am still discussing possible options and ideas with the Mechanical Engineer that designed the system.

- **Critical Industry Issue**

The last analysis, the critical industry issue, will regard researching the method of prefabrication. This will be broken down into two entities: the first will consider the effects of prefabrication on the industry as a whole, while the second will be dedicated to researching the prospect of prefabricating the mechanical roof screen on this specific project.

A. ANALYSIS ONE – *Foundation System and Structural Breadth*

Problem

The original specified foundation system was concrete piles and during the early phases of the job, other parties elected to change the system to a deep foundation in lieu of piles. This change caused drainage and water issues for Gilbane due to the fact that with a deep foundation, a lot of excavating and water pumping is required because you typically will run into wet soils, etc. Weather, specifically rainy days, hindered the progress when excavating for the deep foundation, which is generally not an issue when constructing/installing a pile system.

Goal

The goal of this analysis that I would like to perform involves redesigning the school's foundation system. Pertaining to the problem statement from above, this presents an opportunity to analyze a schedule and cost analysis of the two systems (piles vs. deep foundation) as well as breadth in the structural option. While steel piles are typically more expensive than concrete piles, both will be assessed through this analysis to determine which system best suits the project. This will also allow me to address any water table problems, regarding bearing capacity and hydraulic pressures, the design of temporary foundations or retaining walls and lastly soil remediation. For this analysis, it will be necessary to consult with a geotechnical engineer to discuss the most efficient options for the determined soils of the project. I would also need to contact a structural engineer to discuss the design and load requirements for a potential system, which would also coincide with a cost and scheduling analysis.

Design Analysis

- a. Determine cost of a pile system
- b. Calculate the loading requirements
- c. Size, quantify, and determine locations of the piles according to applicable building codes and loadings

Cost Analysis

- a. Research and determine the present soil conditions and consult with a geotechnical engineer
- b. Determine excavation, dewatering, and installation costs
- c. Size Evaluate any general conditions savings

Schedule Analysis

- a. Calculate duration (from excavation through installation)
- b. Analyze the sequence of activities
- c. Gauge the overall schedule savings achieved

Resources

- a. AE Faculty Members
- b. Gilbane Building Company and the Structural and Geotechnical Engineers on the project
- c. Virginia Statewide Uniform Building Code
- d. R.S. Means Cost Data

B. ANALYSIS TWO – Mechanical Roof Units and Mechanical Breadth

Problem

The mechanical system for the Virginia Commonwealth School of Business and Engineering is located on the roof of the building. The equipment alone was very expensive, but also inflicted a large additional cost of the previously mentioned roof screen. It seems very uneconomical to have such an elaborate system on the roof, rather than create an additional floor when the building is well below the zoning height restrictions.

Goal

The second analysis I would like to perform regards the rooftop mechanical system. I would like to evaluate the rooftop units and explore alternate energy sources or ways to conserve energy for this building and make it more efficient.

It may also be an option to do a cost-comparison and constructability review of building an additional floor for the mechanical system, rather than travel an extravagant route of the complicated and costly roof screen. This could also reflect potential value engineering opportunities.

Such changes to the architecture of the building will need to be addressed with a structural engineer, and the proposed changes to the mechanical system would need to be discussed with a mechanical engineer.

Additional Comment

I recognize that this analysis statement is vague, but I know that I want to do something regarding the mechanical system. I am still discussing various alternatives with the Mechanical Engineer that designed the system for this project. Christmas break will provide me with enough time to narrow and finalize the approach I would like to take with the mechanical system.



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C. RESEARCH ANALYSIS – *Prefabrication of the Mechanical Roof Screen*

Problem

Prefabrication was the first topic discussed at the PACE Roundtable in October of 2007. While individuals within the industry can recognize the benefits of prefabrication, convincing owners and builders of the benefits is more difficult than easy. While prefabrication is currently gaining momentum, it is still not a conventional way of building. There are no standards to prefabrication; there is no single applicable technique. These facts raise difficulty in getting owners onboard early, which is a critical step in prefabrication. On the opposite side of the spectrum, are the subcontractors. As general contractors or construction managers, we must push prefabrication onto a project through the individual trades, making it necessary to recognize the opportunities and integrate them into the design of the structure. While there was a question addressing any union issues within the subcontractors, the panel and attendees expressed that there was little resistance from those union workers. The panel also discussed prefabrication from a green-build standpoint and the potential advantages that it can incur. Due to the fact that green-build continues to be a growing trend in the construction industry, it is logical to relate any sustainable opportunities to the act of prefabrication. Such “green” advantages that prefabrication can invite are a reduction in production costs, more efficient building systems, a better quality of building systems, a lessening of generated waste onsite, and a lower disturbance of the environment through minimizing lay down areas for materials.

- **Prefabrication at the Virginia Commonwealth University**

The rooftop mechanical system of the School of Business and Engineering was concealed by a roof-screen, which was very labor-intensive, timely and costly. The screen is at a 10:12 pitch and involved laborers to be tied-off at 4-stories above ground, installing the wood-blocking and other roofing materials. Crane remobilization around the perimeter of the building induced extra fees. In addition to this, the roof had the majority of the mechanical system installed, so it was hard to find suitable lay down areas for the roofing materials and also incurred limitations to the maneuverability around the massive ductwork. The second analysis I would like to propose would be on the roof screen. I recognize this aspect of the project as a prospect of prefabrication. I would like to research the possibility of prefabricating the roof screen panels, which in turn could condense the schedule and lower any safety factors in having workers of different subcontractors on the steep incline of the roof.

Goal

The purpose of this analysis is to not only address the issues of prefabrication within the construction industry and address the concerns that it inflicts, but through research, to potentially implement this methodology on the roof screen and appraise this impact on the cost and schedule. My core audience will be that of Gilbane, but also extend to owners, contractors, and subcontractors who have concerns about prefabrication.

ANALYSIS TOPICS

Research Tactics

The method of researching this topic will include two branches: one for the industry as a whole and the other will incorporate a more project-specific approach to the how prefabrication of the roof screen would have influenced the construction of the building.

- **Research I – Survey of Industry Members**

The main way that I plan to address prefabrication in the construction industry is to survey owners as well as members who have been in construction field for five to ten years and have had recent experiences, good or poor, with prefabrication. My conclusions will be drawn from a survey that will be deployed, sampled below, which addresses the advantages and disadvantages of applying prefabrication on a project.

ADVANTAGES OF PREFABRICATION

	Least Important	Fairly Important	Important	Very Important	Extremely Important
Reduce Construction Costs					
Better Supervision					
Shorten Construction Time					
Aesthetic Issues					
Waste Improvement					
Site Availability/Lay-down Areas					
Additional Comments:					

DISADVANTAGES OF PREFABRICATION

	Least Important	Fairly Important	Important	Very Important	Extremely Important
Inflexible for Design Choices					
Higher Initial Construction Costs					
Lack of Experience					
Limited Site Space					
Leakage Problems					
Transportation and Crane Costs					
Additional Comments:					

▪ Research II – Gilbane

The second portion of my analysis will be specific to the Virginia Commonwealth University School of Business and Engineering project and the Gilbane team. As stated previously, this research will be dedicated towards prefabricating the roof screen panels to minimize the various issues that it incurred. This analysis will require contact with companies who have worked for Gilbane in the past regarding prefabrication as well as other industry members. One key member is Ted Border of Whiting-Turner Construction. He is extremely familiar with prefabricated construction and would serve as a credible source to discuss whether or not this topic is at all feasible. Mr. Border would be an excellent contact for this analysis as has prefabricated entire roofs on previous projects. I would also have to contact a structural engineer, because while the roof screen conceals the mechanical equipment from the neighboring buildings, it also supports some of the ductwork.

Cost Analysis

- a. Research the materials of the roof screen and their resulting cost
- b. Determine a weight and size per panel
- c. Determine the most effective transportation method and required crane size
- d. Evaluate the amount of labor needed to install the “x” amount of panels

Schedule Analysis

- a. Evaluate the transportation and erection times for the panels
- b. Compare the installation to the progress of other activities
- c. Determine the overall salvaged time

Resources

- a. Industry Members and Survey
- b. Gilbane Building Company
- c. R.S. Means Cost Data
- d. Crane Loading Manuals
- e. Research publications and articles on Prefabrication

SUMMARY AND WEIGHT MATRIX

This proposal intends to address the specific construction issues that materialized at the Virginia Commonwealth University. On the other hand, it also represents a personal challenge in which I will be tested on my skills and knowledge that I have achieved through the Architectural Engineering program. Through pursuing a Structural and Mechanical breadth, I hope to gain a better understanding of these two separate options, which will obviously benefit my overall growth as a future Construction Manager. Problems are frequent when dealing with the structural and mechanical systems on any given project. Working with these two systems will allow me to become more familiar with the two systems and polish the skills that I have thus far attained. Through my research, I hope to develop the ability to recognize the potential situations that prefabrication can be implemented and to subsequently avoid/prevent any of the concerns that currently lie within the method.

Below is the proposed weight matrix that best illustrates how I plan to distribute my efforts among the different analyses that make the body of this proposal.

WEIGHT MATRIX

DESCRIPTION	RESEARCH	VALUE ENGINEERING	CONSTRUCTABILITY REVIEW	SCHEDULE REDUCTION	TOTAL
Analysis I <i>Foundation</i>	5	10	5	15	35
Analysis II <i>Mechanical System</i>	10	10			20
Analysis III <i>Prefabrication</i>	15		15	15	45
TOTAL	30	20	20	30	100%