Thesis Proposal

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CONSTRUCTION MANAGEMENT

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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 involve redesigning Sector C to be a steel structure. Once the design has been completed, the impact on the cost and schedule of the building will be tabulated, with goals of saving both money and time.

- **Analysis II**
  The second breadth topic will assess the mechanical, electrical and plumbing (MEP) coordination that results from redesigning Sector C to a steel structure. This will involve resizing the mechanical equipment, coordinating the sequence of activities, addressing any need to reformat the floor plans. Implementing BIM on this analysis will result in a constructability review.

- **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 – *Structural Redesign*

The first analysis that I will be performing regards Sector C, the School of Engineering, and is structurally driven. This particular section of the building has a concrete framework, while the rest of the building's skeleton is steel. This analysis will consist of redesigning Sector C in steel to match the rest of the building.

Goal

The goal of this analysis is to address the impact of redesigning Sector C to a steel building. By removing an entire trade from the project, it is hopeful that this change will save time and money on the project. The first step to this analysis is to contact the structural engineer to discuss the reasoning behind having two structural systems in one building. It will also be necessary to discuss the design and load requirements for this potential system. Once the redesign is completed, I will then analyze the schedule and cost differences between a steel and concrete framework in this section.

Design Analysis

a. Calculate the loading requirements
b. Determine size and quantity of beams according to applicable building loads

Cost Analysis

a. Research and determine the cost of the required beam sizes
b. Determine the cost of crane rentals and man-hours
c. Compare the cost of a concrete system to that of the redesigned steel system

Schedule Analysis

a. Coordinate the delivery sequence and subsequent lay-down areas
b. Determine the erection time
c. Gauge the overall schedule savings achieved

Resources

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

B. **ANALYSIS TWO** – ***Mechanical, Electrical & Plumbing Coordination***

The second analysis I will be performing is in reference to my pervious breadth topic one. Through redesigning Sector C in steel, I will then address the subsequent mechanical, electrical and plumbing (MEP) coordination that is then involved with the redesign.

Goal

The goal of this analysis is to recognize the fact that the plenum space will be reduced and hence restrict the space that the MEP trades have to work with. This analysis will consist of, but not be limited to, an effort to relocate and/or resize equipment, reroute distribution systems, address any need for potential changes in the floor plans, equipment access and a schedule that minimizes the conflict between the several trades. In an attempt to review the constructability of this redesign, it would be beneficial to implement BIM, using Revit MEP (2008), in the redesign of Sector C to ensure that enough information is being displayed and to detect any clashes between the MEP systems.

Design Analysis

a. Resize equipment to fit into the reduced plenum space
b. Address any need for a potential change in the floor plans of the building
c. Meet access needs for equipment

Cost Analysis

a. Determine a MEP cost/SF of the redesigned systems
b. Determine the associated man-hours for the installation of the redesigned systems

Schedule Analysis

a. Coordinate the activity sequence for the MEP trades
b. Determine the installation times
c. Gauge any schedule savings achieved

Resources

a. AE Faculty Members
b. Gilbane Building Company and the MEP Engineers on the project
c. R.S. Means Cost Data
d. Revit MEP 2008

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.

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 MEP Coordination breadth, I hope to gain a better understanding of these two dependent options, which will obviously benefit my overall growth as a future Construction Manager. Problems are frequent when dealing with the structural and MEP systems on any given project. Working with these two options together will allow me to become more familiar with the involved 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 *Structural Redesign*	5	10		15	30
Analysis II *MEP Coordination*	10	10	5		25
Analysis III *Prefabrication*	15		15	15	45
TOTAL	30	20	20	30	**100%**