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Thesis Final Proposal

George Mason University PE Building

Renovation & Expansion

Fairfax, Virginia

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Executive Summary

In this final proposal, the four analysis topics for the depth part of my thesis and the two analysis topics for the breadth part of my thesis are discussed. The depth portion of my thesis includes the following topics:

- Best delivery method for University projects
- Schedule acceleration using two cranes
- Alternate site logistics
- Energy & the economy

As mentioned in previous technical assignments, the selected delivery method for GMU's PE Building hindered efficiency and relationships on the job. This was the ultimate factor in selecting this as a research topic. Since time is money in the construction industry, trying to accelerate the schedule by erecting both steel sequences simultaneously seems like a viable option. Going along with this topic, the site logistics would be altered due to the use of two cranes. So research into an efficient site plan to accommodate this idea is necessary for it to run smoothly. A concerning industry issue for American business is the increase in use of foreign products. So this topic has been selected to research what American businesses need to do to compete with these incoming products.

The breadth portion of my thesis includes a look into my understanding of the mechanical and structural options within our major. I have chosen to analyze the following areas on GMU's PE Building regarding these options:

- Changing from a sheet metal duct system to a fabric duct system in the gymnasiums
- Reducing the roof thickness due to decreased loading from the fabric duct system

Fabric ducts systems require much less installation time and effort. They are also very cost efficient. These facts led me to research the cost savings that could be associated with this change. Going along with this change, using fabric duct would also decrease the design loading to the roof system since it is much lighter than sheet metal. In realizing this, I felt that

researching this further to see if the roofing system could be thinned out was a viable option. This would result in a cost savings as well from reduced material usage.

Analysis Descriptions

In this section, the three construction management analyses are discussed as well as the critical industry issue. These are the topics I plan to use for the depth part of my thesis proposal.

University Projects Delivery Method

Problem/Opportunity

The delivery method chosen (CM at Risk) may not have been the best choice given that the George Mason staff as well as the Gilbane staff were not used to this method. As mentioned in technical assignment 1, George Mason is used to working with general contractors not construction management firms. The CM at Risk approach was used as a hybrid between the two methods, which in turn created an "interesting relationship" between the two parties. Further research into what delivery methods work best for university projects would be beneficial to improving relationships between the owner and construction firm.

Research Steps

- Conduct my own independent research by reading various articles and case studies about current and past construction projects at George Mason University and The Pennsylvania State University
- Personally interview several industry members that have experience working for jobs on which the Owner is a university.
- Handout a brief survey to around twenty construction industry parties that are able to take the time to answer a few questions about their experiences and opinions.

Required Sources

A number of sources will be required to successfully research this topic. The first and most accessible are articles from various construction magazines. I intend to find a couple of articles that I can compare to my research and collect information about the overall project schedule / delivery methods. The other sources that this research will require is a few people from the construction industry that have enough experience that they will be able to contribute valuable feedback. I plan to speak to one or two members from the Gilbane project team working on the PE Building at George Mason University. I will also use a couple of contacts at The Pennsylvania State University to interview / survey people regarding recent projects on campus.

Sample Survey Questions

- What are some of the university project(s) that you have had experience working on?
- What kinds of project delivery methods (i.e. CM at Risk, Multiple Prime, etc.) were chosen for each of these projects? If these methods were chosen beforehand for a reason, please list the reasons.
- In your opinion, what was the best thing about this kind of project delivery method?
- What was the worst thing about this kind of project delivery method?
- How much of a role did the Owner (the university) play in the project?
- If they played a large role, did you feel that they had too much control over the project?
- Lastly, do you think the project delivery method (especially looking at the relationships with the owner and other contractors) plays an important role in the success / efficiency of the project?

Expected Outcome

I expect to indentify the conditions under which different delivery methods should be used for various university projects like that at George Mason. The delivery method must promote open communication between most parties as to increase project efficiency.

Steel Erection Using Two Cranes

Problem/Opportunity:

The steel sequence for George Mason's PE Building was split into two sequences. Since this project was already behind schedule, I plan on analyzing the option of using two cranes to erect the steel sequences simultaneously. In doing this, the schedule would be accelerated.

Research Steps

- Obtain costs for crane and manpower used to erect the steel
- Calculate costs and durations of using two cranes and the added manpower
- Analyze how this would affect other trades
- Compare the added cost vs. schedule savings

Required Sources

The sources required to perform an in depth analysis of this will be a couple of people from the Gilbane staff and possibly RS Means. The Gilbane staff should be able to provide me with the crane and manpower costs or a contact to get this information. If not, I will use RS Means to obtain the closest comparison possible to the crane size that was used.

Expected Outcome

I expect to show that accelerating the schedule by using two cranes to erect both steel sequences simultaneously would result in an overall cost savings for the project.

Alternative Site Logistics

Problem/Opportunity

The use of two cranes to erect the steel would require a different site logistics plan than that for only one crane. Additional staging space would be needed. Other items may need to be relocated as well to avoid the crane radius of the second crane. I plan on showing how implementing two cranes changes the original plans and come up with an efficient site plan to accommodate this change.

Research Steps

- Obtain original site plans for the steel erection sequences
- Analyze the effects of adding a second crane simultaneously
- Change the site plan to accommodate two cranes efficiently

Required Sources

The required sources needed to perform an in depth analysis of this topic will be a couple people from the Gilbane staff. I would rely on them to provide me with their original site plans made for the two steel sequences. If I'm not able to obtain these, I would use the site plans made in technical assignment two and elaborate on them.

Expected Outcome

I expect to show how the addition of another crane to erect the steel sequences simultaneously would affect the original site plans as well as show that the site while being relatively small, could be organized to accommodate the two cranes and not hinder the rest of the work flow.

Critical Industry Issue – BIM Implementation for Façade Construction

Problem/Opportunity

The many different façade types on GMU's project caused numerous problems for the contractors working on them. They had trouble with connection details and undefined work scopes as to who was supposed to perform it. These issues came up in coordination meetings every time. I believe looking into implementing BIM for this work scope would have been beneficial.

Research Goals

My goals for this are to show that BIM would have provided many benefits and increased the productivity and quality of this work scope. I would also like to show that the expensive upfront cost would be worth it in the long run.

Research Audience

The audience will be construction industries as a whole. They could all benefit in learning about BIM since it is a powerful tool and not vastly used.

Beneficiaries

GMU would benefit for future projects in learning what BIM could do for them. Other construction companies could benefit as well in learning the costs and benefits of BIM and how to make it affordable for all parties.

Research Steps

- Conduct literature research from reputable construction sources such as ENR, construction journals, etc.
- Research the cost and benefits of BIM
- Research why it is still not vastly used in the industry
- Summarize my research results and findings

Required Sources

The required sources needed to perform an in depth analysis on this topic will be literary engineering resources such an ENR magazine, the internet, and several industry members. ENR would be used to find out the benefits of BIM as well as the costs. The internet could be used for this as well, and in finding why BIM is not used often. Industry members could be surveyed to find out their experiences with BIM and what they thought of it.

Conclusions

In conclusion, I hope to demonstrate that I have learned the knowledge to become a well rounded engineer upon graduation with this proposal. While studying Architectural Engineering for the past five years I have been exposed to many different aspects of the construction industry. While my selected option is Construction Management, I hope to be able to show that I have the competencies required to communicate effectively and understand the other realms of the engineering world.

Appendix 1

Breadth Studies

In this section, the breadth topics are discussed. The related options are Mechanical and Structural.

Mechanical - Alternative Duct System

Problem/Opportunity

The Cage Gym and Linn Gym renovations included a new duct system. The New Venue Gym had a new duct system installed as well. These duct systems are standard sheet metal and flexible duct. I am proposing fabric duct systems be used in place of the sheet metal duct in the gymnasiums. Fabric duct systems require much less installation time and are more cost efficient. I plan on showing that switching to a fabric duct system would result in a cost and schedule savings.

Research Steps

- Determine quantity of duct in the three gyms
- Calculate costs for installed duct and components
- Find suitable fabric duct system for gymnasium applications
- Obtain prices for fabric duct system and required installation times
- Compare installed system vs. fabric duct system
- Explore cost savings and schedule impact of fabric duct

Required Sources

The sources needed to perform an in depth analysis on this topic will be the Gilbane staff, internet, and a mechanical contractor. The Gilbane staff will be able to provide me with the costs of the duct systems for the gyms or a contact to get this information. The internet would be used to find a suitable fabric duct system to replace the installed system. A mechanical contractor that has experience installing these type of systems would be able to provide me with material costs and installation times.

Expected Outcome

I expect to be able to show that by switching the duct systems in the three gymnasiums to fabric duct, an overall cost savings and schedule savings would be the result.

Structural – Reducing roof member sizes

Problem/Opportunity

The roofing systems for the three gymnasiums are designed to support the sheet metal duct systems and their required components. Since the roof is typically designed before all mechanical loads and locations are known, it is usually overdesigned. I hope to be able to find the actual mechanical loads of the equipment and show that a smaller member size could have been used, resulting in a cost savings.

Research Steps

- Determine the designed roof loading
- Determine the weight of the installed mechanical equipment
- Determine the actual roof loading
- Calculate the shear and moments and find a new beam size
- Determine the cost savings from the reduction

Required Sources

The sources needed to perform an in depth analysis on this topic will include the architectural drawings, a mechanical contractor, and possibly a structural engineer. I will be able to find the designed roof loading in the architectural drawings. I will need the sizes of the installed ducts and there components off of the drawings as well. The weights for these materials will need to be obtained from either the drawings or from either of the engineers. I will need the input of a mechanical contractor to determine what kind of loads the fabric duct system will apply to the roof.

Expected Outcome

I expect to be able to show that by reducing the member sizes a cost savings would be realized.

Weight Matrix

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Analysis 1 - Delivery Method	10%	0%	0%	0%	10%
Analysis 2 - Schedule Acceleration	5%	0%	5%	30%	40%
Analysis 3 - Site Logistics	5%	10%	5%	0%	20%
Critical Issue - Energy & the Economy	10%	10%	10%	0%	30%
Total	30%	20%	20%	30%	**100%**