Final Proposal

for Spring Thesis Project

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I. Executive Summary:

The purpose of this proposal is to provide an overview of the areas of interest that will be researched for my final thesis report on the Integrated Science Center. The three topics covered include Air Handling Unit Redesign, Existing Windows Versus Replacing Windows for Phase II, and 3D Coordination. The common theme for these analyses is their effects on the mechanical system design and installation.

Analysis I – AHU Redesign
This analysis will focus on the redesign of the AHUs (Mechanical Breadth). The new AHU system would be designed to handle the building demands during Williamsburg's humid summers and decrease the amount of moisture formed. The new design cost would be compared to the original AHU cost plus the additional costs necessary to fix the moisture overflow. This analysis would extend to the rework of the main exhaust duct to fit above the 2nd floor ceiling rather than in the roof chase (Architectural Breadth).

Analysis II – Existing Windows Versus Replacing Windows for Phase II
This analysis will explore the initial cost and long term benefits of replacing the existing Rogers Hall windows. The new window system would improve efficiency, aesthetics, and quality. A comparison will be made to the efficiency and operation costs of the existing window system.

Analysis III (Critical Issues Research) – Implementation of 3D Design Coordination
This analysis will attempt to identify the difficulties of implementing 3D coordination in the construction industry and offer possible suggestions of encouraging 3D models on projects. The worthiness of having all parties, owners, contractor, and subcontractors on the 3D Design Coordination will be explored.

This proposal outlines the areas of research I chose to pursue. These topics will enhance my knowledge in those areas I have previously studied as well as expand my understanding of unfamiliar areas which are still useful in my professional development. A weight matrix diagram is provided to illustrate how effort will be distributed among the different analyses proposed.

II. Analysis Descriptions:

Analysis I – Redesign of AHU's

Problem Statement
The Integrated Science Center is a state-of-the-art facility which contains over 40 fume hoods. All of the ambient air in the building must be exchanged with external air several times per day. Recirculation of air is not permitted, as the fume hoods are integral to the building exhaust system. Unfortunately, the design engineer who specified the air handler units did not take into consideration the massive amount of condensation that forms when operating the system at 100% external air exchange during the humid summer months, and as result, moisture began to overflow the small drain pans and flood the penthouse floor.

Potential Solution
After consulting with the design engineer, fume hood manufacturer, and mechanical contractor, it was decided to operate the system at less than maximum airflow, add moisture eliminators, and install larger drain pans to resolve the issue. I propose designing a new AHU system that could handle the building peak demands during Williamsburg's humid summers. The estimated new AHU cost could then be compared to the current system plus the added expenses for the overflow fixes (larger drain pans and moisture eliminators).

Research Steps

- Become more familiar with the originally designed AHU system (get product data sheets).
- Contact a mechanical professional, preferably from Facility Dynamics who was the mechanical engineer for the ISC project, regarding assistance in designing an air handler unit.
- Research alternative AHU manufacturers and products.
- Redesign the AHU system to accommodate the new demand loads.
- Estimate the cost of the newly proposed AHU.
- Obtain the actual costs for the current AHU and the required repairs of this system from the project manager.
- Compare overall benefit/cost of the two systems.

Expected Results
Although I anticipate the newly designed AHU to have a higher initial cost than the current air handler unit, I expect that measures implemented to resolve the moisture problem with the original AHU's will exceed the difference in cost. Therefore, I believe the cost of the redesigned air handler unit will less than the overall cost of the current AHU.

Analysis II – Existing Windows Versus Replacing Windows for Phase II

Problem Statement

Phase II of the Integrated Science Center project consists primarily of the complete interior demolition and renovation of approximately 25,000 SF of lab space. The original contract documents required the existing window and curtainwall systems to remain protected and in place. However, after evaluating the situation, the option of replacing the windows during demolition was presented. The new window system would improve energy efficiency, aesthetics, and quality. Would installing new windows be cost effective? How would the installation impact the schedule?

Research Goal

I would like to assess both the existing and the proposed window systems and determine if installing new windows would be worth the initial cost. The three main areas I will focus on are material and labor costs for the replacing window system, the variation in thermal efficiency between the old and new systems, and the estimated difference in building operation costs. With this information I can compare the value of each option. The installation of a new window system will add to the project construction time and would need to be integrated into the project schedule.

Research Steps

- Obtain product data information for the existing windows and the proposed window system from the project team.
- Adjust current project schedule with the affects of installing a new window system.
- Request material and construction costs from Gilbane’s project manager.
- Acquire previous Rogers Hall operation costs from the College of William and Mary’s construction and facilities team.
- Based on window efficiency and expected energy consumption, calculate the operating costs of the new system (may require additional help from professor or professional).
- Determine the effects of the new windows on the mechanical system.
- Compare the initial, operating, and overall costs of each system.

Expected Results

Through this analysis, I expect to find the cost of the new windows to be greater than the operational cost savings accumulated throughout the building’s life. Purchasing and installing the replacement windows will initially cost more than keeping the existing windows in place. The thermal efficiency of the new windows is greater than the existing windows which will decrease the energy consumption and costs. Although I don't believe the operational savings will offset the price of replacing the windows, I do believe it would better match the ISC addition and be more aesthetically pleasing. Replacing the window system will add to the project construction time and needs to be incorporated into the project schedule.

Analysis III (Critical Issues Research) – Implementation of 3D Design Coordination

Problem Statement

The use of 3D design coordination programs has been of growing interest in the construction industry. Implementing this on a project however remains a huge challenge. This topic is of interest to me because MEP coordination is crucial for a high-end laboratory, such as the Integrated Science Center at William & Mary. The implementation of a 3D model might have helped this project significantly due to the complexity of the facility.

Research Goal

The goal of this analysis to show the advantages of using 3D design coordination, and present a way of implementing it during construction. It is necessary to educate the owner, contractor, and subcontractors on this technology so that everyone can participate and benefit from using the software. A 3D model can identify many of the mechanical, electrical, and plumbing clashes before they occur in the field. These programs can provide a better visual concept and get everyone involved on the same page. The initial time and costs to develop the model would be minimal compared to the time and money saved by using this technology.

Research Steps

- Review literature on the use of 3D design coordination.
- Research what is involved and needed to produce a 3D clash detection.
- Interview the Gilbane project team about their experiences with 3D design and whether or not they would have preferred its use on the ISC project.
- Question subcontractors on their experiences with 3D design and if it would have been beneficial to them on the ISC project.
- Research similar projects that used 3D clash detection programs.
- Provide a clash detection example.
- Analyze the advantages and disadvantages of implementing it in the construction industry.
- Suggest possible ways of encouraging its use on a project.
- Summarize results with sufficient information.

Possible Interview Questions

1. Have you ever used 3D coordination software on a project?
2. What are some of the challenges faced using this technology?
3. Would 3D coordination been useful on the Integrated Science Center?
4. How and who would be trained for the use of 3D modeling if it were used?
5. What would have been the benefits of using this technology on the project?
6. What necessary steps are needed to implement 3D coordination on a project?
7. What parties would be involved?
8. How does Gilbane initiate 3D coordination to their clients?

Expected Results

Through this analysis I hope to better understand all that is involved 3D design coordination, demonstrate the advantages of this technology, and provide suggestions for the challenging issues that arise with its use. I would like to illustrate the functionality of using clash detection for the mechanical, electrical, and plumbing systems and encourages its use in the construction industry.

III. Conclusion:

Through the analysis described in the previous section, I hope to provide a thorough construction management study on the Integrated Science Center project at the College of William and Mary. This proposal summarizes the topics I will research for my thesis during the Spring 2009 semester. This project is an opportunity to apply everything I have learned over the last five years as well as expand my knowledge in areas that will be useful in the construction industry.

IV. Weight Matrix:

The weight matrix below shows the different analyses that will be areas of investigation addressed in the thesis proposal. The proposed topics will be analyzed in areas such as value engineering, constructability review, and schedule reduction.

The analysis of an alternative air handler unit will require some research of different AHU products. The redesign of the AHU would have an effect on the constructability. An evaluation of location and position of mechanical floors could be taken into consideration. Ultimately, construction time would be saved because remedies for moisture carry-over would no longer be required.

Replacing the existing window system with a new window system is a possible option to provide value to the building. The increase in thermal efficiency would decrease energy consumption costs and could possibly ease mechanical coordination. A detailed benefit/cost analysis could then be submitted to the owner for consideration.

The research for the 3D coordination will mostly consist of literature review and interviews. A 3D model can identify many mechanical, electrical, and plumbing clashes before they occurred in the field thus reducing schedule time and construction costs.

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
AHU Redesign	5%	-	15%	15%	35%
Window Systems	-	20%	15%	-	35%
3D Coordination	25%	-	-	5%	30%
Total	30%	20%	30%	20%	100%

Figure 4.1 – Weight Matrix Diagram

APPENDIX

Appendix A – Breadth Studies

Breadth Studies

While completing the construction management analyses for the Integrated Science Center, I plan to investigate other area specialties of the Architectural Engineering program. The breadth studies I have selected are briefly explained below.

Mechanical Breadth

The Integrated Science Center is a state-of-the-art laboratory facility and it requires an elaborate mechanical system. During the humid summer months caused an excessive amount of condensation formed when the system was operating the system at 100% external air exchange. As a result moisture began to overflow the drain pans and flooded the penthouse floor. I would like to propose a new AHU system that could handle the building peak demands during Williamsburg's humid summers.

Architectural Breadth

The original design specified that all mechanical work was to be installed above the 1st and 2nd floor ceilings. However, it became apparent that the main exhaust duct for the Phase II facility could not be installed above the 2nd floor ceiling due to the inordinate amount of laboratory piping, electrical work, and fume hood connections crammed into the space. Therefore, the main exhaust duct, along with many of the main chilled, hot water and steam condensate lines were relocated from above the 2nd floor ceiling to the now crowded roof chase. The duct was then run to the new manifold which connected the exhaust to Phase I. I would like to reanalyze the mechanical room locations and equipment, and equipment positions and propose a way to install the main exhaust duct above the 2nd floor ceiling rather than in the roof chase.

Appendix B – Thesis Research Time Line

Thesis Research Time Line

Date	Analysis	Research Schedule
1/11-1/24	Analysis I	Become more familiar with the originally designed AHU system (get product data sheets)
1/11-1/24	Analysis I	Obtain the actual costs for the current AHU and the required repairs of this system from the project manager
1/25-1/31	Analysis I	Research alternative AHU manufacturers and products
2/1-2/4	Analysis I	Contact a mechanical professional regarding assistance in designing an air handler unit
2/1-2/21	Analysis I	Redesign the AHU system to accommodate the new demand loads
3/1-3/7	Analysis I	Estimate the cost of the newly proposed AHU
3/15-3/21	Analysis I	Compare overall benefit/cost of the two systems.
3/15-4/4	Analysis I	Revisions
1/11-1/24	Analysis II	Obtain product data information for the existing windows and the proposed window system from the project team
1/11-1/24	Analysis II	Request material and construction costs from Gilbane's project manager
1/11-1/24	Analysis II	Acquire previous Rogers Hall operation costs from the College of William and Mary's construction and facilities team
1/25-2/7	Analysis II	Adjust current project schedule with the affects of installing a new window system
2/1-2/28	Analysis II	Based on window efficiency and expected energy consumption, calculate the operating costs of the new system
2/1-2/28	Analysis II	Determine the effects of the new windows on the mechanical system.
3/15-3/21	Analysis II	Compare the initial, operating, and overall costs of each system.
3/15-4/4	Analysis II	Revisions
2/22-3/7	Analysis III	Review literature on the use of 3D design coordination
1/11-1/24	Analysis III	Interview the Gilbane project team about their experiences with 3D design
1/11-1/24	Analysis III	Question subcontractors on their experiences with 3D design
2/22-3/7	Analysis III	Research similar projects that used 3D clash detection programs
3/22-3/28	Analysis III	Provide a clash detection example
3/22-3/28	Analysis III	Analyze the advantages and disadvantages of implementing it in the construction industry
3/22-3/28	Analysis III	Suggest possible ways of encouraging its use on a project
3/15-4/4	Analysis III	Revisions

Figure B.1 – Research Time Line Chart

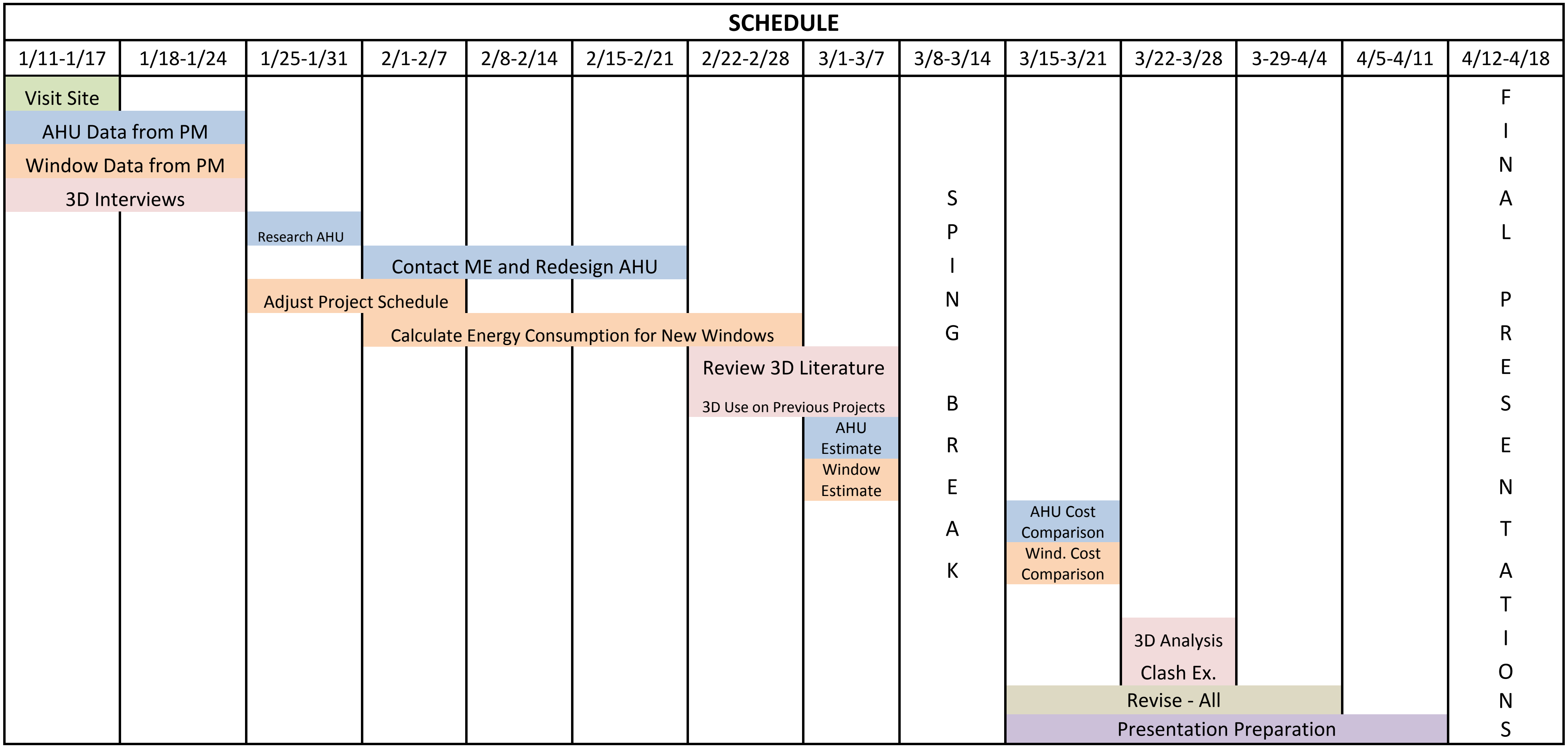

Figure B.2 – Research Time Line Graph