Renovation of an Office Building in Washington D.C.

Washington, D.C.

Final Proposal

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Executive Summary

Senior Thesis Final Proposal is intended to discuss the four analyses that will be performed for the final thesis report on the Office Building Renovation. Each topic is centered on the central theme of energy and improving efficiency in the construction industry.

ANALYSIS #1: Critical Industry Issue – Integrated Project Delivery

Integrated Project Delivery (IPD) is an up and coming delivery method that could really impact the design and construction of the Office Building. This analysis will be conducted by speaking with industry professionals that have experience with IPD and by researching case studies of projects that have been completed by using IPD. Additionally, the faults and shortcomings of the design-bid-build delivery method will be examined in the coming semester.

ANALYSIS#2: Feasibility and Design Study for Photovoltaic Panels on the Green Roof

The Office Building project is slated to achieve LEED Gold Certification upon completion. However, as a public funded project, the Office Building should be doing everything possible to achieve LEED Platinum Certification. It should lead by example and take the extra steps to achieve this. The goal of this analysis is to perform a preliminary design of a building integrated PV energy system on top of a green roof and determine the financial feasibility to incorporate the system into the SmartGrid to reduce energy costs for the owner. This analysis will include the second part of the Critical Industry Issue research by analyzing how the PV panels can be incorporated in the SmartGrid. A structural breadth study will also be performed for analyzing load requirements and additional structural support for the PV panels. Also, an electrical breadth study will be performed to determine a system tie-in location along with electrical equipment and connection requirements for the renewable energy system.

ANALYSIS #3: Digital Modeling and Coordination of the MEP System

A problematic feature of the Office Building is the density of MEP installation that needs to be placed into the 12" plenum space. The space needs to be utilized by numerous subcontractors for items including fire protection, cable tray, branch duct, branch piping, duct mains, supply air ducts, returned air register, and hot/cold water piping. Digitally modeling the MEP Systems will improve coordination between the trades and help with the constructability. A mechanical breadth study will be performed concerning the phasing and coordination of the Chilled Water Plant in the sub-basement.

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ANALYSIS #1: *Shift from Design-Bid-Build to Integrated Project Delivery Method*

PROBLEM IDENTIFICATION

The current project delivery method for the Office Building is a traditional Design-Bid-Build. A design-bid-build delivery method is one of the most common and familiar delivery methods. However, it can create some problems along the way due to lack of coordination. The design is completed in stages and then pieced together at the end before it is sent out for bid to the contractors. This prevents each design firm from working together and creating one, cohesive design for the building. Additionally, with the design-bid-build delivery method, constructability issues with the design are not discovered until the bid process or during construction. Additional costs can result from these late findings if the design process is not closely monitored.

RESEARCH GOAL

The goal of this analysis is to investigate the benefits and possible outcomes of using an Integrated Project Delivery Method compared to a traditional Design-Bid-Build. The design efficiencies and constructability methods that can be gained with this delivery method will also be examined closely.

METHODOLOGY

- Contact the General Contractor to receive information about issues that have dealt with concerning the Design-Bid-Build delivery method
- Find/research case studies of projects that have been designed and built using Integrated Project Delivery
- Compare data for projects completed under an IPD method and Design-Bid-Build
- Develop a summary of findings and provide possible guidelines for success when delivering a project with IPD

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- General Contractor: information about issues with current delivery system
- Case Studies of projects that have used IPD
- Applicable literature

EXPECTED OUTCOME

Understanding that this analysis is much more qualitative as compared to the following technical analyses, it is believed that this study will demonstrate how an Integrated Project Delivery Method can benefit this project in terms of a more efficient design and construction practices.

ANALYSIS #2: *Feasibility and Design Study for Photovoltaic Panels on the Green Roof*

PROBLEM IDENTIFICATION

The Office Building project is slated to achieve LEED Gold Certification upon completion. However, as a public funded project, the Office Building should be doing everything possible to achieve LEED Platinum Certification. It should lead by example and take the extra steps to achieve this. Photovoltaic (PV) roof panels set on top of the already planned green roof is one step the owner can take. The fact that the owner will own and occupy this facility for over 50 years makes PV panels a great option in sustainable design and reusable energy.

RESEARCH GOAL

The goal of this analysis is to determine the feasibility, advantages and disadvantages of implementing photovoltaic panels onto the green roof of the Office Building. A quantification of the amount of energy that a standard PV panel can produce will be obtained and then translated into power generation that the building could provide as a whole. The analysis will cover the initial costs of installation as well as determining the payback period of the system.

The intention is that the PV panels on top of the green roof will reduce the energy consumption by the tenants in the long-term operation of the building. It is understood that there will be a greater upfront cost with the addition of the panels. However, through analysis, I hope to find that the long-term benefits will outweigh the short-term investment and ultimately save the tenants and owner money.

METHODOLOGY

- Research PV panel technologies and sustainable design techniques
- Research sustainable roofing systems and the effectiveness of the combination of PV panels and green roof
- Determine quantity of panels to be placed on roof and amount of kWh able to be produced
- Analyze how the PV system will connect to the existing electrical power system (Electrical Breadth)
- Perform feasibility analysis on life-cycle cost and payback period

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- AE Faculty – Structural
- GHT, Ltd. – MEP Engineers/Designers
- Dr. Riley
- Applicable literature

EXPECTED OUTCOME

Through extensive research and design, it is expected that a building integrated photovoltaic energy system combined with a green roof will provide the Office Building with an attractive financial benefit through reduction in power grid dependency. It is not feasible to produce all of the building energy loads with the PV system and green roof, but a significant portion will be accounted for with the renewable energy source. It is believed that the financial model will prove that the PV system is affordable and financially beneficial due to different financing options and lifecycle cost considerations.

ANALYSIS #3: *Coordination of the Chilled Water Plant*

PROBLEM IDENTIFICATION

The interior of the Office Building was completely demolished with the exception of an existing chilled water plant located on the Subbasement level, which provides chilled water for an adjacent building and must remain in operation 24/7. The chillers in the subbasement are eventually going to be replaced, but they are being replaced in the exact location of where they sit now. The project manager identified this as the largest constructability challenge. Building Information Modeling (BIM) was used on this project, but it could have been used more effectively to deal with this problem.

RESEARCH GOAL

The goal of this analysis is to determine how BIM could have been used more effectively to help with the coordination of the chilled water plant. As far as acoustics are concerned, the goal is to reduce the airborne sound pressure of the temporary chillers by placing sound barriers around the temporary chillers

METHODOLOGY

- Research the benefits of modeling MEP Systems in the design phase
- Contact MEP engineer/designer for design consultation
- Analyze how BIM could have been used more efficiently to help with the coordination of the Chilled Water plant.
- Attain the acoustical information of the temporary chillers from the manufacturer and determine a way to reduce the airborne sound pressure (Acoustics Breadth)

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- GHT, Ltd. – MEP Engineers/Designers
- General Contractor/Construction Manager Project Team – MEP Coordination/logistics
- Applicable literature

EXPECTED OUTCOME

After completing extensive research, it is believed that BIM could have been used more efficiently to help with the coordination of the chilled water plants. If temporary chillers were the way to go from the beginning, BIM could have helped with this.

ANALYSIS WEIGHT MATRIX

The weight matrix, show below in **Table 1**, illustrates how each analysis accounts for the four core areas of investigation. The percentages represent expected time and effort that will be allocated for the different proposed analyses.

Analyses Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Shift in Delivery Method	10%	5%		15%	30%
Photovoltaic System	10%	10%	15%		35%
Digital Modeling - MEP	5%	10%	10%	10%	35%
Total	**25%**	**25%**	**25%**	**25%**	**100%**

Table 1: Weight Matrix

TIMETABLE

In order to stay on task and meet project goals, a preliminary semester timetable has been developed to schedule work progression for each technical analysis. See ***APPENDIX B*** for the spring semester preliminary timetable.

Appendix A

Breadth Topics

BREADTH TOPICS

The following topics involve a more detailed analysis in distinct technical disciplines within the major. Each topic contributes to the previously mentioned analyses, which are identified accordingly.

ACOUSTIC BREADTH: *Contributes to both Technical Analysis #3*

An acoustical analysis of the temporary chillers will be performed. The temporary chillers are located outside in the parking lot of the job site. These chillers can be very loud and disruptive to the construction workers and people working around the job site. The current sound output will be looked at and then a method will be chosen that will reduce the sound that comes from the temporary chillers. Once a method is chosen, calculations will be made to determine the reduction of sound. The goal is to bring the targeted wavelength to reduce the noise for workers during construction or people working nearby.

ELECTRICAL BREADTH: *Contributes to Technical Analysis #2*

A detailed analysis of the potential energy production that the Office Building will generate with the addition of the PV panels on the green roof will be carried out. Hand calculations using square foot area and acquired energy production data will be the main source of the breadth. Once this information is obtained, it will be used to calculate life cycle costs and potential savings for the building.

Appendix B

Spring Semester Preliminary Timetable