Renovation of an Office Building in Washington D.C.

Washington, D.C.

Final Proposal

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Revised: January 12, 2011

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.

ANALYSIS #4: Prefabrication of the Glass Curtain Wall

The façade of the building is a mixture of existing granite and limestone panels and glass curtain wall. Working with two different systems can provide many challenges in the field concerning the constructability of the façade. The goal of this analysis is to replace the designed curtain wall system with a prefabricated curtain wall system. A preliminary design of a prefabricated curtain wall system will be performed and impacts to schedule, cost and trade coordination on site will be assessed. This analysis will include a portion of the structural breadth by analyzing and designing additional supports and connections.

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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
- Develop/distribute a list of questions for industry members regarding Integrated Project Delivery method and public funded projects
- 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 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.

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
- Contact PV panel manufacturers for design consultation
- Determine quantity of panels to be placed on roof and amount of kWh able to be produced
- Research financing plans or options for purchasing energy that would be viable for the owner
- Analyze how the existing structure will be affected with the added load from the PV panels
- Analyze how the PV system will connect to the existing electrical power system
- 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 – Great Knowledge of SmartGrid and Sustainable Design Techniques
- 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: *Digital Modeling and Coordination of the MEP System*

PROBLEM IDENTIFICATION

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. MEP coordination was also an issue because the drawings of the original building showed the plenum space as completely open when in fact there were multiple concrete beams that ran through the plenums. Another challenge was the existing Chilled Water Plant in the sub-basement. The chilled water plant serves an adjacent building and must remain in operation 24/7 throughout the entire construction period. However, all of the chillers in the plant have to be replaced in the same location where they sit now.

RESEARCH GOAL

The goal of this analysis is to determine how digital modeling or other technologies could have been used to help with coordination and to reduce confusion between the MEP trades. Digital Modeling of the MEP System can also be beneficial if an Integrated Project Delivery Method was used.

METHODOLOGY

- Research the benefits of modeling MEP Systems in the design phase
- Research the upfront costs of modeling the MEP Systems
- Contact MEP engineer/designer for design consultation
- Analyze the schedule, cost, and constructability impacts of modeling the MEP Systems

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 digitally modeling of the MEP Systems in the design phase will improve the coordination between the MEP trades and improve

constructability in the field. While the digital modeling of the MEP systems may prove to be more expensive up front, the savings in schedule and change orders should cover the added costs.

ANALYSIS #4: *Prefabrication of the Glass Curtain Wall*

PROBLEM IDENTIFICATION

The façade of the building is a mixture of existing granite and limestone panels and glass curtain wall. Working with two different systems can provide many challenges in the field concerning the constructability of the façade. The connections can be very time consuming and quality could be lost along the way. There are added difficulties because the granite and limestone panels are existing while the glass curtain wall is new construction. Having a curtain wall that is prefabricated in a factory will simplify the installation and the connections to the existing panels. The Curtain Wall is on the critical path for the Office Building so any reduction of schedule specific to the Curtain Wall will have tremendous impact on the overall schedule.

RESEARCH GOAL

The goal of this analysis is to perform a preliminary design of a curtain wall system and assess the impacts on schedule, cost and trade coordination on site.

METHODOLOGY

- Research current curtain wall system and select applicable manufacturer
- Contact manufacturer for design consultation
- Design preliminary prefabricated curtain wall system for the Office Building
- Analyze how the curtain wall system impacts existing structure and design necessary connections
- Assess impact on limestone panels and curtain wall interfaces
- Determine transportation and erection requirements for pre-fab curtain wall system
- Analyze schedule, cost and constructability impacts of the pre-fab curtain wall system
- Analyze site congestion and trade coordination improvements

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- Curtain Wall Designer/Manufacturer – Harmon, Inc.
- AE Faculty – Structural
- General Contractor – Site coordination/logistics
- Applicable literature

EXPECTED OUTCOME

After completing extensive research and an in-depth design, it is believed that a prefabricated curtain wall system will effectively reduce the curtain wall schedule and improve the trade coordination to eliminate inefficiencies due to site congestion. While the prefabricated curtain wall system may prove to be more expensive up front, the savings in schedule should cover the added costs.

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%			10%	20%
Photovoltaic System	5%	10%	5%		20%
Digital Modeling - MEP	5%	10%	10%	5%	30%
Prefabricated Curtain Wall	5%	10%	10%	5%	30%
Total	**25%**	**30%**	**25%**	**20%**	**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.

STRUCTURAL BREADTH: *Contributes to both Technical Analysis #2 and Technical Analysis #4*

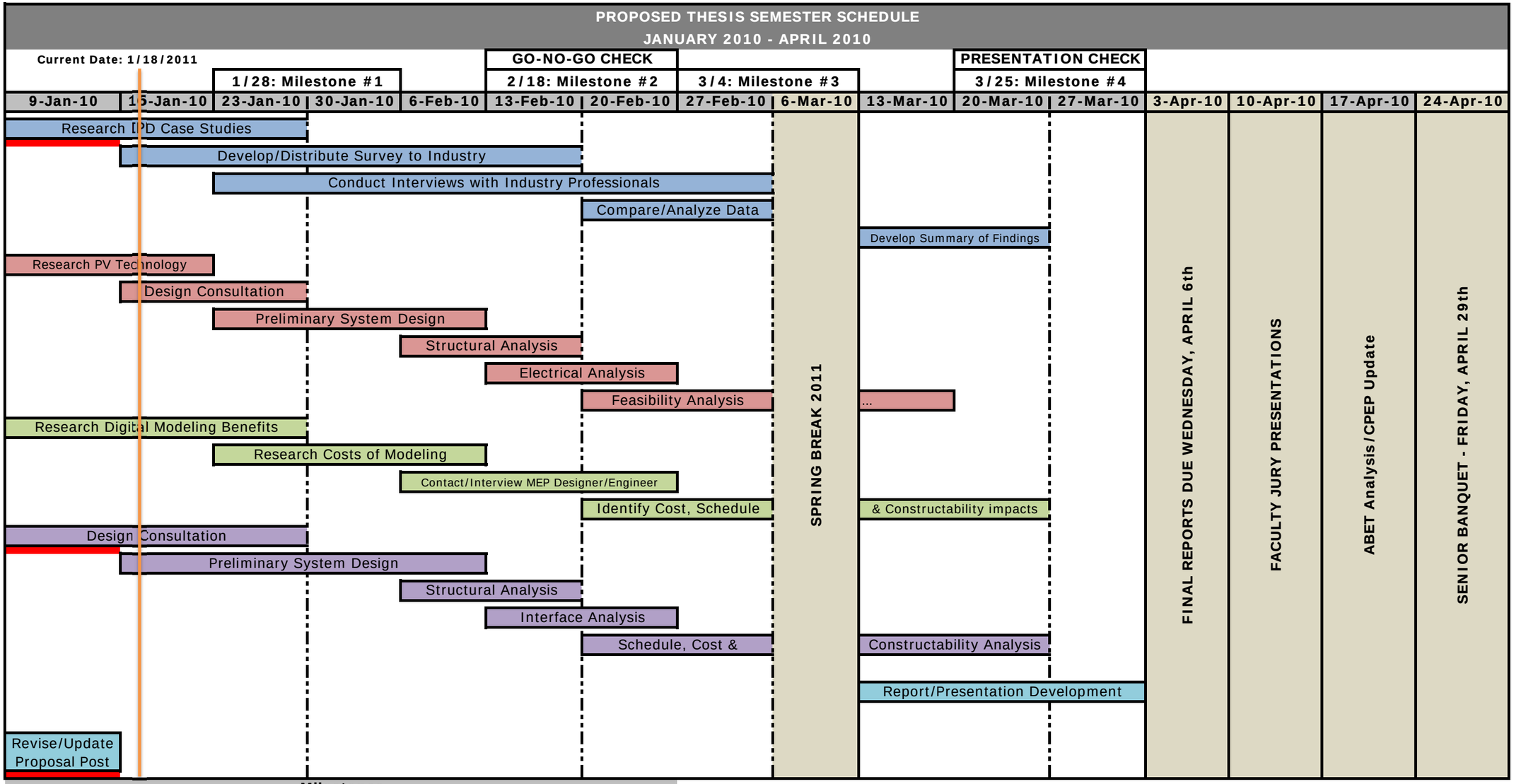
There are two areas where the structural system can be analyzed. As proposed in Technical Analysis #2, the addition of photovoltaic panels on the roof will require a structural analysis to determine loading and support requirements. The substitution of a prefabricated curtain wall system, as proposed in Technical Analysis #4, will be analyzed to determine the effects on the existing structure. Any additional support and connections that are determined to be required for both the photovoltaic panels and prefabricated curtain wall will be designed and evaluated for cost and schedule impacts.

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



Milestones

1 (Jan. 28)	Complete all Design Consultations for Analyses #2 and #4.
2 (Feb. 18)	Complete Preliminary Designs for Analyses #2 and #4 and Complete Research for Analyses #3.
3 (March 4)	Complete all Industry Interviews for Analysis #1.
4 (March 25)	Complete Analysis #2.

Progress

- Analysis #1: Critical Industry Issue - Integrated Project Delivery
- Analysis #2: Feasibility and Design Study for Photovoltaic Energy System
- Analysis #3: Digital Modeling and Coordination of the MEP Systems
- Analysis #4: Prefabrication of the Glass Curtain Wall
- Breadth #1: Structural Breadth (Included in Analysis #2 and #4)
- Breadth #2: Electrical Breadth (Included in Analysis #2)