Final Thesis Proposal

77 K STREET

Washington, DC

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December 18, 2007

77 K Street

Final Technical Proposal

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Executive Summary

This final proposal report will serve as an outline for spring coursework in AE482. The overarching theme for the proposal is LEED accreditation based on the LEED Green Building Rating System for Core & Shell Development Version 2.0. Spring coursework will explore various outlets for the 77 K Street project achieving additional accreditation points. Cost and schedule implications of such changes will also be considered.

Analysis 1: Commercial Office LEED Analysis

This critical industry research topic will explore the opinions of developers and owners in regard to pursuing LEED accreditation. It has been commonly accepted that LEED accreditation adds value to a building but it also comes at a higher upfront construction cost. Through the use of surveys, this analysis will assess whether owners and developers are willing to pursue sustainable, LEED accredited projects given these added initial costs.

Analysis 2: Window and Solar Shade Design (Mechanical and Solar Breadth)

By adjusting the current window and shadow box design on the building, solar gain can be optimized during winter and summer months. This analysis will focus on energy savings and obtaining LEED points. A mechanical breadth will be incorporated by calculating the change in the cooling load on the HVAC system resulting from the change in direct solar rays entering the building.

Analysis 3: Green Roof Design (Structural Breadth)

Green roofs can be a central feature of LEED accredited projects. The structural impacts of adding a green roof will be assessed and the roofing system will be redesigned as needed. The cost and schedule implications of such an addition will be addressed as well.

Analysis 4: Short Interval Production Schedule Development

Short interval production schedules often lead to reduced project schedules when highly repetitive activities occur in a project. Through the development of a short interval production schedule (SIPS), the overall schedule will be reduced and tracking work flow will become much easier. The “parade of trades” and schedule reduction will be illustrated through the use of a 4D model.

I. Introduction

The 77 K Street project is a class A core and shell office base building project consisting of 11 above grade levels and 3 levels of below grade parking garage. The site is located at the intersection of 1st and K Streets in Washington, DC in the North of Massachusetts development district north of the Capitol Building. The project includes approximately 350,000 gross square feet of above grade office space and an additional 100,000 square feet of below grade parking.

Based on feedback from the owner, Brookfield Properties, the overarching theme of my thesis proposal is LEED accreditation. The 77 K Street project is not pursuing LEED accreditation though the idea was considered but not until well into the design and planning process. After conducting a LEED benchmark survey, the design team realized that the building only achieved a 4.8% energy savings, significantly shy of the 14% minimum LEED prerequisite requirement. Because the idea was first considered late in the project and significant time and cost implications would be incurred, the project team opted not to pursue accreditation though minor LEED items are being pursued for the sake of sustainability and efficiency.

The major theme of my research efforts will be analyzing the feasibility and cost implications of making this building LEED certified. Key areas that will be explored include natural lighting and the incorporation of a green roof. Initially, the building will be assessed to see how many points the facility would currently achieve. Then, a green roof and window design analysis will be performed in order to push the building one step closer to achieving LEED accreditation.

As a means of reducing the overall project schedule I am proposing developing a short interval production schedule (SIPS). Through the process of creating the critical path method (CPM) schedule in technical assignment number 2, I began to see opportunities for the implementation of a short interval production schedule (SIPS). By beginning to utilize the labor force more efficiently the project could begin to operate in a more lean and productive manner, not only saving time but saving money as well.

II. Analysis 1: Commercial Office LEED Accreditation Analysis

Critical Industry Research

A. Problem Statement

It has been commonly accepted that LEED accredited buildings have reduced operating costs and improved occupant health. It has also been established that most LEED accredited buildings have higher initial construction costs. Research is required in the commercial office sector in order to determine owners' views on their willingness to accept higher upfront costs in order to achieve life-cycle savings and improved tenant health.

B. Goal

Research will identify the opinions of owners of commercial office buildings and their perception of whether or not it is advantageous to pursue LEED accreditation on their buildings. Are owners/developers willing to spend more for a building given the advantages associated with LEED accreditation? Are tenants willing to pay more on their rental rates to occupy a LEED accredited space knowing the benefits they will achieve in terms of occupant productivity, health, and happiness? Industry research will attempt to assess these questions.

C. Research Steps

1. Create an industry survey to distribute to commercial office building developers / owners that will assess their view on pursuing LEED accreditation.
2. Have faculty consultant review the survey in order to improvement the desired outcome.
3. With the assistance of contacts in the general contracting and construction management sector, compile a list of 10-15 developers / owners to contact.
4. Distribute industry survey via email relatively early in the spring semester.
5. Compile responses to the survey.
6. Develop conclusions based on industry responses. Assess whether developers / owners are interested in pursuing LEED accreditation given higher upfront construction costs. Assess whether they believe that their tenants are willing to accept higher rental rates given the benefits associated with LEED accredited spaces.

D. Expected Outcome

Based on the survey developed, I expect that owners and developers in the commercial sector would be willing to accept higher construction costs in order to develop LEED spaces. The long term benefits, including financial operating savings, outweigh the upfront costs and a developer who retains and operates their property would likely be very willing to accept higher initial costs in order to achieve a higher return on their investment. Being a new trend in the building industry, owners also will likely be on the forefront of the LEED trend. I am very interested to see what the opinion on increased rental rate may be. I suspect that tenants would be unwilling to spend significantly more on rent in order to occupy a LEED accredited space.

III. Analysis 2: Window and Solar Shade Design

Mechanical & Solar Breadth

A. Problem Statement

The current window and shadow box layout does not consider solar angles. Designing the windows to reduce solar gain during the hot summer months when the sun is high in the sky and allowing solar gain during the winter when the sun is lower will potentially allow for reductions in HVAC loads. This process will also allow 77 K Street to gain LEED credits in the Indoor Environmental Air Quality category of the LEED Core & Shell Version 2.0 Rating.

B. Goal

The goal of this design process is to achieve at least three points towards LEED accreditation. A reduction in the cooling load would also be a major benefit of redesigning the window layouts. This could save a significant amount of money as well for the owner in the form of energy cost savings.

C. Research Steps

1. Perform an analysis of the current window layout to assess solar angle infiltration into the building.
2. Develop a Microsoft Excel spreadsheet to document the heat gain and loss through the existing windows. ASHRAE standards will be used.
3. Redesign the windows and shadow boxes to maximize solar heat gain in the winter and reduce solar heat gain in the summer months.
4. Document heat gain and loss through the redesigned window system.
5. Evaluate the LEED Core & Shell Rating System to determine which points have been achieved.
6. Assess cost impacts of the redesigned system.

D. Expected Outcome

The redesigned window and shadow box layout will result in reduced cooling loads to the HVAC equipment. This will result in energy savings for the owner. It will also result in the ability for the owner to achieve LEED points in the Daylight & Views category of the LEED rating. The addition of overhangs and changing the sizes of the shadow boxes may be necessary which will have cost impacts as well. It is assumed that the redesign will save the owner money but a thorough financial assessment to the project will be performed.

IV. Analysis 3: Green Roof Design

Structural Breadth

A. Problem Statement

Though a green roof design was being considered at one point in the project, the current roof does not incorporate a green roof. The lack of a green roof leads to significant heat loss through the top of the building. Failing to have a green roof also leads to the inability to secure numerous points in the sustainable sites and energy categories of the LEED Core and Shell Version 2.0 rating system.

B. Goal

The goal of this design process is develop a green roof that will reduce heat loss through the top of the structure. The roof will also reduce storm water run-off from the site. Both of these objectives will help 77 K Street achieve LEED points as well.

C. Research Steps

1. Perform research into various types of green roof designs. Inquire from various manufacturers about the benefits of various systems.
2. Pick a green roof system that is most appropriate for this project.
3. Evaluate the structural implications of the roofing system.
4. Redesign the concrete roof in order to hold the new roofing system. Design will be based on the ACI code.
5. Evaluate the LEED Core and Shell Rating System to determine which points have been achieved.
6. Assess cost and schedule impacts of the redesigned system.

D. Expected Outcome

The green roof system will be substantially more expensive than the current hot fluid-applied roofing system. It will also have significant schedule impacts on the project. Nonetheless, the roofing system will reduce heat loss and thus reduce HVAC loads. It will also reduce storm water runoff from the building. The new roof will be more expensive than the current roofing system but the added benefits will appear in the form of energy savings and contributions towards achieving LEED accreditation.

V. Analysis 4: Short Interval Production Schedule Development

A. Problem Statement

As outlined in technical report number two, the current schedule has gaps in work sequence that result in inefficient crew utilization. A "parade of trades" does not clearly flow through the building. Consequently, lean production does not occur. Though the current schedule is highly effective, the implementation of a short interval production schedule (SIPS) will lead to overall schedule reduction and improved trade flow.

B. Goal

The implementation of a SIPS schedule will result in an overall schedule reduction. The focus of the SIP schedule will be the interior trades found on all typical floors (MEP, masonry, drywall, etc.). The SIPS will also allow for easier tracking of production based on standardized work zones and task durations.

C. Research Steps

1. Define sequence of work.
2. Quantify each activity.
3. Determine productivity rates based on current schedule.
4. Define work zones within the building (i.e. floor 2, floor 3, etc.).
5. Establish standardized work durations for all activities in each work zone.
6. Level the resources in order to achieve consistent work durations.
6. Layout SIPS schedule.
7. Compare SIPS schedule duration with existing critical path method schedule.
8. Evaluate cost impacts based on changes in resources, particularly labor.
9. Develop a 4D model of the existing schedule and a separate 4D model of the SIPS schedule to illustrate the improvement in workflow and overall schedule reduction.

D. Expected Outcome

The SIPS schedule will result in an overall schedule reduction. This is in part because the SIPS schedule lends itself to the ideal learning curve of repeating a single task until it is completed throughout the building. Repetition leads to production efficiency. The schedule is also more predictable making it easier for the general contractor to track and communicate the schedule compared to a standard CPM schedule. For the short interval production schedule to work though, there must be full buy-in from all trades and subcontractors.

VI. Summary

One of the key areas that could have been pursued on the 77 K Street project is LEED accreditation. Throughout my spring coursework I hope to gain a deeper understanding of the LEED accreditation process. Through interaction with industry professionals, doing research into cutting edge green technologies, and performing cost-benefit analyses I will gain a better understanding of the U.S. Green Building Council's LEED process and its implementation on commercial office buildings, such as 77 K Street. During this process, I will learn how to identify value engineering sources, evaluate the constructability of alternative design options, improve my critical thinking skills, and interact with members of the professional community.

Weight Matrix

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
LEED Accreditation	20%	10%			30%
Window and Shade Design	5%	15%	5%		25%
Green Roof Design	5%	5%	10%		20%
SIPS				25%	25%
Total	30%	30%	15%	25%	100%