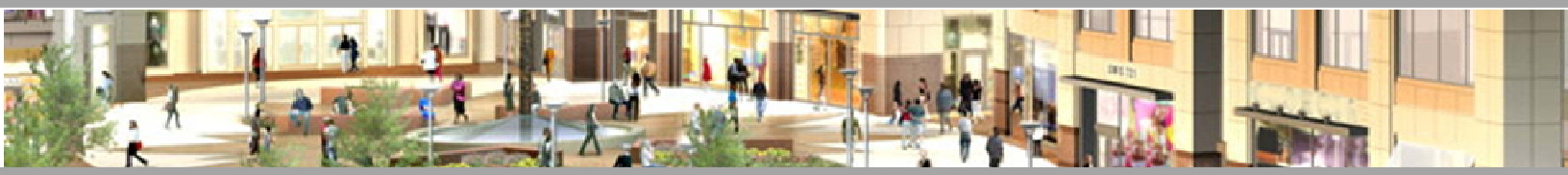
Wisconsin Place Residential

Chevy Chase, MD



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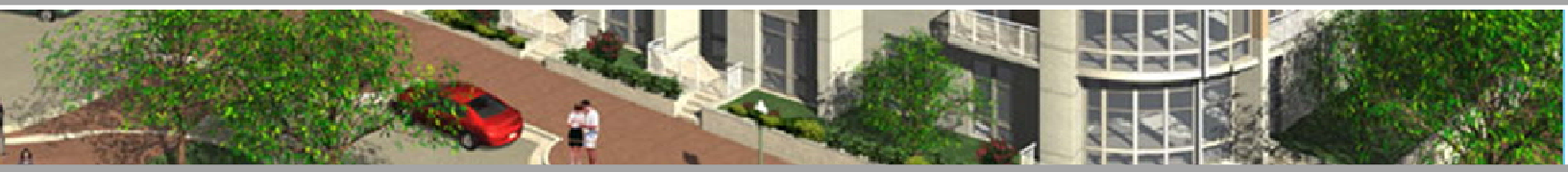

Revised Thesis Proposal
April 5, 2008

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Executive Summary

Prefabrication Depth

The major theme of my thesis will be prefabrication and the building façade. I intend to perform detailed research to investigate its current state in the modern day industry. Prefabricated systems have been around for a while, but I feel that many groups are unsure of how to utilize them to their utmost advantage. By looking at case studies, peer reviewed articles, and industry opinions I will determine some of the best applications of prefabricated brick systems as well as shed light on some cutting edge technologies that have not yet reached the masses.

Analysis 1: Precast Panel Implementation

As part of my prefabrication research I will redesign the façade of Wisconsin Place Residential to be a prefabricated brick enclosure. The reasons for doing this include the site congestion, coordination issues, and schedule constraints. My prefabrication research should help me select the optimum choice for the building. Embedded in this area is my structural breadth. The connection details for the precast panels to the post-tensioned slab will be designed and methods to improve the moisture resistive and thermal characteristics of the envelope were investigated, as these are areas of concern with prefabricated materials. A schedule and budget review will determine the feasibility of construction. All of these results will be processed to make a final recommendation of changing to precast.

Analysis 2: Photovoltaic Glass Replacement

A class about building envelopes brought me to the idea of using photovoltaic glass as a way to convert solar energy from the sun into electrical energy for the building. Yes, this solar cell glass is more costly than regular, but its benefits can greatly pay off over time. This analysis will look at the energy benefits to utilizing PV cell panels in a functional manner as windows. The idea is to replace all of the foot-level glass panels with PV glass since they will not obstruct the view from the apartments. As my mechanical breadth, I will use the software program Energy10 to determine the energy savings per year from adding these PV panels to the façade. The cost of implementing the PV panels will be considered. After taking all of these factors into consideration, I will make a final decision and recommendation for the energy-saving system.

Weight Matrix

The weight matrix shows the degree of emphasis that will be placed on the core areas of research, alternative methods, value engineering, and schedule compression. A detailed explanation of my breadth studies can be found in Appendix A. The purpose of the breadth is to show my proficiency in at least two option areas outside of construction, those being structural, electrical, and acoustical.

Prefabrication Depth

Problem Statement

Prefabrication is an incredibly useful tool available to the construction industry today. Unfortunately, it has a stigma attached to it that makes some owners cringe when they hear the word. While prefabrication has been around for hundreds of years, it is still very misunderstood. Owners and designers need a better basis for making the decision to go prefab.

Goal

Through this prefabrication research I wish to determine the origins of prefabrication and what has kept the concept going for so many years. This depth study will identify the advantages and disadvantages to prefabrication and describe a model to help owners make the decision of using prefabricated materials. Finally, since the theme of this thesis project is the building façade, I will research and compare various types of precast brick panels systems. This will ultimately assist in selecting a specific product to be used on the Wisconsin Place project.

Research Steps

1. Gather research on the history of prefabrication.
2. Research methods for deciding to choose prefabrication.
3. Identify the advantages and disadvantages of prefabrication.
4. Research prefabricated facades and compare products.
5. Research new technology for prefabricated brick facades.

Site congestion could be reduced by utilizing prefabricated materials.

Tools

1. Journal of Construction Engineering and Management
2. Journal of Aerospace Engineering
3. PACE conference
4. KPFF Consulting Engineers
5. ASCE Journal of Architectural Engineering
6. Penn State Libraries

Expected Outcome

The results of this prefabrication research should be further enlightenment as to why the decision to implement prefabricated items is such a complex one and to establish a fixed method to make the decision. After comparing different precast brick panel systems I would like to select one to use in my Analysis 1 precast façade implementation.

Analysis 1: Precast Panel Implementation

Problem Statement

Wisconsin Place is a project faced with many constraints including time, money, resources, and space. The site is extremely crowded already, and some of the concurrent projects have yet to begin. Conditions will only worsen as time wears on. Turner and all subcontractors onsite could benefit greatly by simplifying the building process in as many ways as possible.

Goals

It is my goal through this analysis to simplify the construction of the façade by limiting the number of trades that need access to it. The intent is to reduce the amount of trades working in one space and to accelerate the schedule. Potential cost savings exist in the shortened project timeline as well as the removal of the masonry hoist and scaffolding from the project scope. This analysis will also address structural design considerations, specifically reducing the exterior loads and connection to the post-tensioned slabs. Finally, thermal performance is a predominant concern whenever precast is introduced to the façade. A governing factor in the selection of a panelized system will be its resistance to the elements. Overall, superior quality, productivity and performance can result from the implementation of precast panels. It is just a matter of selecting the appropriate system for the project.

Research Steps

1. Research precast systems and determine the most relevant one for this project.
2. Calculate the load associated with prefabricated panels.
3. Design the panel to slab connection detail.
4. Create a site layout plan to allocate a holding space for the panels.
5. Modify the schedule to show time savings.
6. Modify the budget to show the cost differential.
7. Determine constructability issues associated w/ prefabrication.
8. Determine thermal load differential between the existing and proposed systems.
9. Calculate the costs associated with crane, scaffolding, and hoist usage.
10. Make recommendation of proceeding with precast system.

Tools

1. RS Means 2008 Edition
2. Smith-Midland Corporation
3. PCI Code
4. Turner GMP Budget
5. AISC Steel Construction manual
6. Whole Building Design Guide

Expected Outcome

I think that the schedule can be greatly reduced by using precast brick panels for the exterior cladding. This could eliminate the need for a material hoist and scaffolding. In turn, it will increase the demand on the crane. I expect to see a cost increase in selecting a precast system over a stick-built one, but hope to find savings in other areas like hoist and scaffolding removal. Coordination will become a more critical issue. The panels will need to be delivered to site in the order they are to be erected, and they may need a staging area. I plan to address this by developing a site layout plan that will allocate material storage areas and delivery routes.

Analysis 2: Photovoltaic Glass Replacement

Problem Statement

Building operating costs can be astronomical in this technologically savvy world. Many of these advanced devices require electrical power to function. Photovoltaic glass panels can supplement the electrical power that is streamed to Wisconsin Place from nearby transformers. Even though PV glass is more expensive, I would argue that the windows will pay for themselves eventually and may save the owner/residents a great deal in electric bills.

Goals

I will determine the advantages and disadvantages of using PV glass in a high rise apartment building in Chevy Chase, Maryland. I aim to quantify the amount of electrical energy that can be generated from one panel of PV glass and how that translates to the entire building. This analysis will quantify the amount of energy savings and utility costs that result from the PV glass replacement and determine if the glass replacement is feasible from a financial and energy standpoint.

Research Steps

1. Research photovoltaic glass, advantages and disadvantages.
2. Estimate the amount of glass in the curtain wall and windows.
3. Compare prices of regular glass to PV panels.
4. Attend Energy10 tutorial session and learn program.
5. Calculate the energy savings associated with switching to PV glass.
6. Calculate life cycle cost.
7. Show schedule impact of replacing glass.
8. Determine whether to stick build or prefab PV glass.
9. Make recommendation on PV glass replacement feasibility.

Tools

1. RS Means 2008 Edition
2. Whole Building Design Guide
3. Energy10
4. National Renewable Energy Laboratory
5. BP Solar
6. US Green Building Council
7. Xantrex

Expected Outcome

My hope is that this photovoltaic glass will be an upfront investment that saves on operating costs in the long term. Since Wisconsin Place is a rental apartment building, I am assuming the owner will hold onto it for a few years as opposed to selling it immediately following construction. This fact leads me to believe that the owner will buy into the idea of a value-enhancing alternative even if means reaching deeper into their pockets initially.

Weight Matrix

The following is a weight matrix that shows the level of emphasis to be placed on each of the four areas of research for my senior thesis.

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Prefabrication Depth	15%	0%	10%	10%	35%
Analysis 1 - Precast Panels	10%	10%	10%	5%	35%
Analysis 2 - PV Glass Replacement	5%	5%	10%	10%	30%
Total	30%	15%	30%	25%	100%

Appendix A: Breadth Studies

Breadth 1: Precast Façade Structural/Thermal Analysis

I am proposing to change the façade of Wisconsin Place from stick built to precast panels in an attempt to reduce the schedule time and site congestion. The panels must tie into the post-tensioned slab, so I will be designing all of those connections. In addition, I will design a typical bolt and angle connection. I also will perform thermal calculations to determine the R-value of my proposed panels versus the original stick-built system. I then will calculate the summer cooling and winter heating loads. As my construction analysis, I will look at the cost and schedule impacts of changing the structural system.

Breadth 2: PV Glass Mechanical/ Life Cycle Cost Analysis

I am proposing to replace the glass curtain wall glass with photovoltaic glass, silicon-coated panels that convert solar energy from the sun into electrical energy that can then be used to power the apartment building. I will calculate the cost of both regular and PV glass from its initial purchase to its removal to determine the most cost effective choice. I will calculate the amount of energy savings per year achieved by using PV glass instead of regular glass. To relate back to my overall theme of prefabrication, I will determine whether the PV glass exterior is better constructed stick built or prefabricated into a window frame. I will determine the cost and schedule issues associated with each method.