

CAMPUS SQUARE BUILDING

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Thesis Proposal
December 11, 2009
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Executive Summary

This thesis proposal is intended to outline the topics I plan to research in the spring 2010 semester. Four separate analyses will be conducted, all focused on possible improvements made to the Campus Square project in areas of alternative construction methods and design, and energy efficiency. Through these analyses, I hope to improve value of the project to the owner through value engineering, constructability review, schedule reduction, and research of topics identified at the PACE Roundtable.

Analysis I – Critical Issues Research – Building Envelope Study

This analysis will be a study on the importance of building envelope efficiency. Energy efficiency has become a very important facet in construction and sustainability as a whole. Researching the importance and the impacts of a well constructed building envelope as means to reduce operating costs and energy consumption will be the main goal of this analysis.

Analysis II – Prefabricated Exterior Panels

This analysis will focus on the impacts to the constructability, schedule, and cost of implementing prefabricated exterior panels on Campus Square. A prefabricated system was not used on Campus Square due to the initial lack of demand for a quickly delivered building. If tenants were secured early in preconstruction, a prefabricated envelope could have assisted in delivering an accelerated project, albeit at a higher overall cost.

Analysis III – Façade Analysis for Thermal Performance

This analysis will determine how the different façade types of Campus Square perform against thermal infiltration through heat loss calculations. By comparing the curtain wall system and the high performance masonry veneer, as well as the proposed prefabricated system discussed in Analysis II, a study may be conducted in determining the benefits and disadvantages of each individual system.

Analysis IV – Structural Redesign of Façade Connections

This analysis will consist of a structural redesign of the connections between the superstructure and the proposed prefabricated system discussed in Analysis II. The masonry veneer system currently implemented on Campus Square attaches to the steel members and composite deck by steel angles. The prefabricated system will require the connections to the building to be engineered to compensate for differing construction loading, as well as other load types.

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Analysis I – Critical Issues Research – Building Envelope Study

Background Information & Overall Goals

Energy efficiency in buildings has become a very important facet in the construction industry, not only as a means of sustainability, but also as an important way of reducing energy consumption and costs. With rising energy costs, it is critical to deliver a well designed and constructed building. A building's envelope is a critical aspect of energy efficiency and sustainability, for thermal losses through the exterior of a building can be very costly, as well as make for an uncomfortable building to work and live in. The high performance envelope system installed in Campus Square was yet another facet of the owner's goal of building highly sustainable, energy efficient building. The goal of this analysis is to research the emerging technologies and trends associated with building envelopes, as well as the constructability impacts associated with these technologies.

Methods

- Conduct literature reviews and professional articles associated with building envelope technologies
- Research systems which have proved successful in both quality and costs
- Analyze systems which could be implemented on Campus Square
- Develop conclusions about the importance and impacts of building envelopes

Resources

- Professional journals and articles on the topics of building envelopes
- Gannett Fleming, Inc. (structural designers for Campus Square)
- Structural and CM AE faculty

Expected Outcome

Through this analysis, I hope to become more familiar about the importance of high performance building envelope systems, as well as emerging trends and technologies on this topic. Furthermore, I hope to discover potential systems which may be applied to Campus Square in order to propose an alternative system which would make the building an even more efficient and sustainable structure

Thesis Requirements Fulfilled

- Critical Issues Research
- Constructability Review

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Analysis II – Prefabricated Exterior Panels

Background Information & Overall Goals

GreenWorks Development, the owner of Campus Square, chose not to utilize prefabricated exterior panels because of the lack of tenant interest during preconstruction. The project team did have prefabrication as an option to accelerate the schedule, but was value engineered out early in the conceptualization of Campus Square. In this analysis, I will explore the impacts of implementing prefabricated exterior panels as a means to accelerate the schedule, as well as deliver a higher quality enclosure to the building. My goal of this proposed redesign will be to analyze cost, construction sequencing, and schedule reduction.

Methods

- Conduct interviews with the architect, structural engineer, and GC project manager for potential prefabricated systems which can be implemented on Campus Square
- Conduct literature reviews of potential systems
- Conduct interviews with prefabrication supplier
- Determine costs and scheduling impacts of new system
- Develop new construction schedule and façade estimate

Resources

- Ganflec Architects & Engineers, Inc. (Architect for Campus Square)
- Gannett Fleming, Inc. (Structural Engineer for Campus Square)
- Wohlsen Construction Company (project manager)
- AE structural faculty
- R.S. Means

Expected Outcome

By implementing a prefabricated system for the façade of the building, I expect a much quicker enclosure duration once the superstructure is erected. However, this method will result in a higher CSF for the façade, and will also result in a crane needed onsite to erect the panels. Overall, this system will be more costly, but will reduce the construction schedule.

Thesis Requirements Fulfilled

- Constructability Review
- Schedule Reduction
- Critical Issues Research

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Analysis III – Façade Analysis for Moisture and Thermal Performance

Background Information & Overall Goals

Campus Square hosts a sizable curtain wall system along North 3rd Street which spans four stories, and is about one third of the square footage of that face of the building. Furthermore, the building implements a masonry façade and storefront system throughout the remaining faces of the building. With thermal efficiency of buildings emerging as an important aspect of sustainability and energy efficiency, studying various assemblies will highlight the importance of a well built envelope. The goal of this analysis is to measure the thermal efficiency by calculating the heat loss of the different envelope systems, including the prefabricated system discussed in Analysis II. Conclusions obtained from the analysis will compare energy efficiencies of each assembly.

Methods

- Determine thermal ratings of all materials used in envelope systems
- Perform literature review of submittals related to envelope materials
- Interview architect on decisions about material selection reasoning
- Perform take-offs of measurements of materials
- Analyze thermal efficiency and moisture infiltration levels
- Compare systems, and determine any energy efficiency benefits of prefabricated systems versus those constructed onsite based on cost and performance.

Resources

- Ganflec Architects & Engineers, Inc. (Architect for Campus Square)
- Moses Ling and other AE faculty with knowledge of thermal properties of façade assemblies
- Prefabricated panel supplier for thermal properties of product

Expected Outcome

I expect the prefabricated system will be the better overall choice of enclosure systems. Due to the controlled environment of the system's construction, a higher level of quality can be achieved. However, the higher thermal efficiency will be proportional to the increased CSF. The high efficiency masonry assembly used on Campus Square will prove to be above standard, and the decision of the project team to VE out an additional curtain wall system along Reily Street (as discussed in Technical Report III) will prove to be beneficial in thermal savings. Although the

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curtain wall system is aesthetically pleasing and allows for increased daylighting, the system will prove to be more thermally inefficient and less sustainable.

Thesis Requirements Fulfilled

- Critical Issues Research
- Value Engineering

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Analysis IV – Structural Redesign of Façade Connections

Background Information & Overall Goals

As mentioned in previous analysis sections of this proposal, Campus Square was constructed using a masonry façade system, coupled with a curtain wall system. If a prefabricated system was used for the exterior of the building, the structural connections which fasten the prefabricated panels to the structure would need to be modified. The goal of this analysis is to understand the connection design used for the current façade, and then redesign the connection detail in order to facilitate a prefabricated system. **Figure 1** below, illustrates the current steel angles used to support the masonry façade system.



Figure 1 – Masonry Façade Steel Support Angles

Image courtesy Wohlsen Construction Company

Methods

- Understand current structural design of exterior masonry system
- Contact structural engineer of Campus Square about potential solutions of redesign
- Conduct literature review of prefabricated system
- Establish schematic structural design of connections
- Analyze impacts of alternate connection system. Estimate cost and schedule changes associated with implementing design

Resources

- Gannett Fleming, Inc. (structural designers for Campus Square)

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- Wohlsen Construction Company (project manager for Campus Square)
- Structural AE faculty
- Prefabricated panel manufacturer (to be decided)
- R.S. Means

Expected Outcome

The new structural connection will be more complex than the original steel angles currently used to support the façade. I intend on implementing a prefabricated system that is more complex than just simple masonry panels. I will be looking at entire wall assemblies which can be assembled offsite, erected, and connected to the superstructure. The new connections will need to be stronger in order to support this added weight. This may involve more reinforcing along the edges of the structure. The connections should not impeded too heavily on the overall constructability and sequencing of the project.

Thesis Requirements Fulfilled

- Critical Issues Research
- Value Engineering
- Constructability Review
- Structural Breadth Study

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Proposal Summary

The intent of the proposed areas of investigation is to address the building envelope, specifically the façade, of Campus Square. Through the separate analysis sections, I hope to discover the importance an efficient, functioning envelope; as well as alternative façade systems which may be prefabricated in order expedite the construction process. All four topics incorporate construction management considerations through value engineering, constructability, schedule impacts, and costs impacts. My research will further develop my professional development as an architectural engineer, but also highlight the importance of sustainability and energy efficiency.

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Weight Matrix

Table 1 – Weight Matrix below shows a breakdown on how I plan to distribute my time and efforts between my proposed analysis topics.

| Description | Research | Value Engineering | Constructability Review | Schedule Reduction | Total |
|--------------|-----------|-------------------|-------------------------|--------------------|-------------|
| Analysis I | 15 | | 5 | | 15 |
| Analysis II | 5 | | 15 | 20 | 40 |
| Analysis III | 5 | 10 | | | 20 |
| Analysis IV | 5 | 5 | 10 | 5 | 25 |
| Total | 30 | 15 | 30 | 25 | 100% |

Table 1 – Weight Matrix

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Appendix A – Breadth Studies

Breadth One: Structural

This analysis will consist of a structural redesign of the connections between the superstructure and the proposed prefabricated system discussed in Analysis II. The masonry veneer system currently implemented on Campus Square attaches to the steel members and composite deck by steel angles. The prefabricated system will require the connections to the building to be engineered to compensate for differing construction loading, as well as other load types.

Breadth Two: Mechanical

This analysis will determine how the different façade types of Campus Square perform against thermal and moisture infiltration. By comparing the curtain wall system and the high performance masonry veneer, as well as the proposed prefabricated system discussed in Analysis II, a study may be conducted in determining the benefits and disadvantages of each individual system.

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Appendix B – Spring Semester Schedule