THE PENNSYLVANIA STATE UNIVERSITY
DEPARTMENT OF ARCHITECTURAL ENGINEERING
SENIOR THESIS

UPMC Passavant Pavilion

Pittsburgh, Pa

Thesis Proposal

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Executive Summary

This Thesis Proposal outlines the topics for which I plan to conduct research and analyze during the Spring 2009 Semester. Overall there are five research topics outlined in this proposal. Each topic is described through the independently with a problem statement, goal, research steps and expected outcome. Following the conclusion section at the end of this document is the Weight Matrix which outlines the distribution of my efforts as I conduct my research and deliver my final report.

The first proposed technical analysis topic is research into the implementation and use of mobile information technology documents. This new technology can be utilized to make digital construction documents available throughout a construction site and provides the opportunity for the use of mobile project management functions. This is one of the first forms of computer technology that is created for primary use among construction field staffs and tradesmen. My research will investigate the ways in which this technology can be introduced into an industry which, historically, is slow to adopt technology.

The second proposed technical analysis topic is an investigation into the viability of utilizing precast concrete sandwich panels in lieu of masonry brick veneer on metal stud backup. This investigation will look at the cost and time savings associated with this change. The structural design of the support details and the integrity of the overall building enclosure system will need to be considered in this investigation as well.

The third proposed technical analysis topic is a means by which to alleviate the site congestion that occurs on the UPMC Passavant Pavilion project. Research into this area will require an investigation into the overall construction schedule and its use in the derivation of the delivery schedules. Alternative site utilization plans and delivery routes will also be compared to the existing and a determination made as to the best possible means by which to organize the site and the required on-site deliveries.

The fourth proposed technical analysis topic is the use of Short Interval Production Schedules (SIPS) during the construction of the 4th through 6th floors of the Pavilion. The integration of SIPS will be investigated for its possible role in regaining time that may be lost during delays that occur early on in the construction process. The repetitive nature of these floors may prove that the utilization of SIPS is a viable time recovery option.

The fifth proposed technical analysis topic is an investigation into the required levels of Infection Control Risk Assessments (ICRA) utilized on the project. An in depth study of the ICRA requirements of UPMC and the Pennsylvania Department of Health (DOH) will be conducted to understand the process of choosing the appropriate level of project for the different locations within an existing and fully operational hospital during renovations. The contract documents specify certain levels of ICRA for each area of renovation and these will be compared to the levels which are required by the owner and the DOH to determine if any cost or schedule savings can be realized from levels above those that are required.

As this proposal outlines the course of action which I will pursue during my research into the above mentioned topics it will increase my knowledge in those areas which I have studied during my course of study, as well as, in those areas unfamiliar to me but vital to my professional development.

Analysis 1 – Mobile Information Technology Documents

Problem Statement

In recent years the construction industry has began to adopt many new forms of technology. These technological advancements have been primarily aimed towards the design and engineering sides of the industry. This tends to generate a technological gap between the field supervision and design teams but the introduction of mobile information technology documents has began to bridge this gap.

Increasing the use of any emerging technology can be difficult but is especially challenging when the sector of the industry it is geared towards is historically slow to accept technological changes. This is due in part to the computer and technology based skill levels of the workers. In order to make the use of this system more prevalent, a way of introducing and utilizing the technology must be developed that eases the field workers into its use.

Goal

The goal of this analysis is to develop a means by which to successfully implement this technology into the field side of the industry. The implementation plan must be one in which even the most technology adverse foreman or superintendent would be able to utilize the system. Once the plan is developed the overall benefits of the use of such a system can be discussed. These benefits include expedient release of revised construction documents which enables the field staff to utilize the most current set of documents which eliminates the possibility of field errors caused by the use of outdated drawings. Another benefit is the ability of trade contractors to note field issues directly in the field and have them instantly accessible by all members of the construction and project management teams.

Research Steps

1. Discuss the technological background, usage, and implementation of these systems with a known system developer.
2. Interview a construction team which has experience utilizing the system.
3. Interview an owner that has utilized the system on one of their projects.
4. Survey at least 10 general and subcontractors to determine their needs and apprehensions when integrating a new form of technology into their company.
5. Conduct literature review on mobile construction documents and communications.
6. Develop a preliminary implementation plan that is geared towards field staff and tradesmen.
7. Discuss plan with those parties interviewed in steps 1 and 2.
8. Finalize implementation plan.

Data Collection Tools

Sample Survey Questions

1. Within the previous one to two years have you been approached or considered implementing any new form of technology into your field operations?
2. If you have not considered implementing a new form of technology into your field operations what are your apprehensions?
3. Have you heard of mobile information technology documents, more precisely mobile computer technology allow for the use of digital field drawings?
4. What are your perceived thoughts on the advantages and disadvantages of utilizing digital field construction drawings in the construction industry?
5. How technology savvy are your field foremen and do you believe they would be willing to utilize mobile computer technology in their daily routines?
6. Do you believe digital construction documents could, in the future, replace paper drawings completely?
7. Field errors caused by the use of outdated construction documents are a common occurrence in the industry. Has your company been affected by this trend and if so what is the average cost of rework on a typical project?

Interview Format

Software Developer Interview

1. What is the goal of mobile information technology documents?
2. Do you see the use of digital construction documents increasing in the future years?
3. Do you believe that digital construction documents will, in the future, replace paper copies?
4. What are the limitations for the implementation of this emerging technology?
5. With an aging work force, how do you plan to implement computer technologies to a non-computer generation and what level of training is necessary?
6. What are the advantages of digital construction documents? Disadvantages?
7. Do you envision your product being utilized mainly by the project management team or by the field staff and tradesmen as well?

UPMC Passavant Construction Team Interview

1. What is your experience with mobile information technology documents?
2. Do you believe that digital construction documents will, in the future, replace the use of paper copies?
3. What are the advantages of digital construction documents? Disadvantages?
4. How accepting of this new technology was your field staff and what were the barriers, if any?

5. Was this technology utilized by tradesmen and subcontractors?
6. What do you believe are the potential uses for this new technology within the construction industry?
7. How would you implement mobile construction documents internally and externally with subcontractors?
8. What physical requirements are needed for a successful implementation; e.g. mobile computers, large digital displays in meeting rooms, digital kiosks throughout the construction site?
9. Would you recommend using this technology on future projects either as an internal management practice or project wide?
10. Field errors caused by the use of outdated construction documents are a common occurrence in the industry. Has your company been affected by this trend and if so what is the average cost of rework on a typical project?

Owner Interview

1. Why was this technology utilized on your project and was it instigated internally?
2. How successful was the implementation of mobile information technology documents on your construction project?
3. How was this technology utilized by your project staff internally?
4. How was this technology utilized by the project team overall; architects, engineers, general contractor, subcontractors?
5. What are the advantages of digital construction documents to an owner? Disadvantages?
6. What do you believe are the potential uses for this new technology within the construction industry?
7. Do you believe that digital construction documents will, in the future, replace the use of paper copies?
8. Would you recommend using this technology on future projects either as an internal management practice or project wide?
9. What was the additional cost, if any, of implementing this technology? Was it deemed acceptable to bear this cost?

Expected Outcome

The expected outcome of this research is to determine the most successful way in which to implement this emerging technology into an industry and demographic that is often more adverse to accepting and implementing new technology. By determining the needs and apprehensions of these groups a comprehensive plan can be developed that will be comprehensive and applicable to the entire field segment of the construction industry. This comprehensive plan can then be utilized to yield the benefits of such a system.

Analysis 2 – Precast Concrete Sandwich Panels vs. Brick Veneer with Light Gauge Framing Backup

Problem Statement

The exterior building enclosure of the UPMC Passavant Pavilion is composed mainly of aluminum and glass curtain wall, metal panels, and masonry veneer on light gauge metal framing backup. When investigating the construction methods for each of these systems it is evident that the masonry portion of the enclosure is the aspect that is not panelized. The curtain wall system is shop fabricated and erected in large floor to floor sections and the metal panel system is installed in large sheets.

The construction of the masonry veneer can be both a time and space consuming venture. In order to erect the masonry veneer first scaffolding must be built in the area that construction is taking place. On a tight site, such as Passavant, the scaffolding can and does consume a large portion of the working areas. It also must be stored on site when it is disassembled as the construction activities progress around the building. Once the scaffolding is erected only then can the work on the masonry veneer begin and as one can see this creates a delay between the start of the masonry activities on site and the actual start of the construction process.

The construction of the masonry veneer also requires a great deal of time and manpower. Adverse weather conditions can increase the overall durations of these activities, as well, as rain and subfreezing temperatures can halt the progress for that day.

Goal

The goal of this analysis is to determine if the masonry veneer can be replaced by precast concrete sandwich panels. The analysis will investigate the constructability, scheduling and cost implications of such a change and will be weighed against those of the original system. From the analysis the most viable option can be determined and implemented into the project evaluation. This analysis will be utilized as the structural and building enclosure breadth for my thesis proposal.

Research Steps

1. Compile project information that relates to the construction of the masonry veneer.
    a. Project Schedule
    b. Construction Costs and Budget
2. Compile information on precast concrete sandwich panels.
    a. Product Data
    b. Connection and Installation Details
    c. Thermal Properties
    d. Other Relevant Information
3. Review site conditions that may restrict or permit the use of either system.
4. Investigate and note any constructability concerns pertaining to either system.
    a. Determine if there are any differences in the interfaces of the two systems with the remaining building enclosure components.
5. Analyze the current structural bearing details for the masonry veneer and determine if they are sufficient for precast concrete panels.
6. Redesign structural bearing details, if appropriate, and all other necessary connection details for the precast concrete sandwich panels.
7. Analyze the thermal efficiencies of each system and compare each the other.
    a. Will the use of precast concrete sandwich panels affect the mechanical requirements of the facility?
8. Develop a schedule and budget for the alternate system.
9. Compare the two systems and make a determination as to the most viable solution.

Expected Outcome

It is expected that from this analysis the time, cost and overall site space savings of utilizing precast concrete sandwich panels in lieu of masonry veneer will be evident. The cost of construction of the precast concrete is expected to be lower than those of the masonry veneer due to the differing manpower needs and the overall material costs. Precast panels should also produce a cost savings due to their prefabrication and the overall onsite construction durations. Through this analysis I hope to show that the use of the precast panels is a more viable solution than the masonry veneer in terms of time, cost, and space requirements.

Analysis 3 – Site Congestion

Problem Statement

The construction site at the UPMC Passavant Pavilion is restricted to those areas immediately adjacent to the footprint of the new Pavilion. The site is bounded to the north by the existing East Wing of the hospital, to the south by Cumberland Road and to the east and west by vehicular entrances to the hospital's existing facilities.

Since this project is an addition to an existing hospital campus all entrances and traffic patterns must be maintained as near as possible to their current state. With that in mind all construction activities must occur within the confines of the construction site. This can be a daunting task as the large deliveries need to be made to the site on a daily basis.

The ideal delivery scenario for making deliveries to the construction site would be to restrict Cumberland Road to a single lane of traffic and off load all trucks from the road side. While this road is a private road the hospital requires that the road be maintained with two travel lanes at all times.

In addition to deliveries the site can also become congested with the staging areas for the many contractors that are on the site throughout the duration of construction. While many of these contractors are on site for short periods of time, i.e. steel erection and concrete contractors, the areas they occupy are annexed into other contractor's staging areas.

Goal

The goal of this analysis is to determine the most efficient manner in which to alleviate the amount of congestion on the UPMC Passavant Pavilion construction site. This analysis will investigate the manner in which deliveries are scheduled and how they relate to the construction schedule and the activities of other contractors. From this analysis the cost and scheduling implications of alternative delivery schedules and site utilization plans will be weighed against one another and the original. The most viable option will then be chosen and integrated into the overall fabric of the project.

Research Steps

1. Compile construction schedules, delivery schedules and site utilization plans.
2. Interview on site field supervisors and foremen to determine the manner in which they are utilizing the construction site.
3. Review the documents from step 1 and the information gathered during interviews.
4. Develop alternative delivery schedules and delivery methods.
5. Investigate usage of off-site holding areas to alleviate site congestion.
6. Evaluate the alternatives from step 4 individually and against one another and the original plan.
7. Determine the most viable site utilization, delivery schedule and delivery method that alleviates or manages the overall congestion on the construction site.

Expected Outcome

Through the proposed investigation more efficient site utilization plans, delivery methods, and delivery schedules may be derived. Scheduling inefficiencies and delays caused by site congestion can then be mitigated to an acceptable level. As the time lost due to site congestion is decreased the opportunity arises to maximize the overall construction schedule.

Analysis 4 –Short Interval Production Schedules (SIPS)

Problem Statement

When completing a construction project delays, ranging from insignificant to major, can arise and must be handled in an expedient manner so that costs are not incurred because of untimely completion. If a delay does in fact occur it is important for the project team to be resourceful and thorough in their examination and mitigation of the problem. Many methods should be investigated to determine how to best manage the situation.

One method which aids in the recovery of time from delays is to increase the production of the construction crews. This can be achieved through the creation of Short Interval Production Schedules (SIPS). SIPS increase the production of crews by laying out a plan of action and a parade of trades for the areas involved in the schedule. This method sets a strict time frame in which each trade is required to complete their work so that the subsequent trades can stay on schedule. While SIPS are generally not used in healthcare facilities due to their complex nature and unrepetitive floor plans, the 4th through 6th floors of the UPMC Passavant Pavilion offer the opportunity to utilize this scheduling method due to their repetitive nature.

Goal

The goal of this analysis is to investigate the project schedule for the 4th through 6th floors and determine if SIPS are a viable means in which to attempt to make up any lost time caused by delays from earlier in the project. SIPS can, and in many cases do, increase the productivity of the building trades that are included in the schedule. This regimented process requires the timely completion of each activity within the schedule. SIPS may be best utilized on the interiors portion of these floors after the building dry in milestone date when finishes can begin to be installed. Further investigation may reveal that SIPS are also a viable method for the steel superstructure and concrete floor system as well.

Research Steps

1. Research SIPS development methodologies.
2. Compile construction schedules and durations for each of the activities on the 4th through 6th floors.
3. Consult with the general contractor to receive input on the effectiveness of SIPS on their construction projects.
4. Develop SIPS based on information gathered in steps 2 and 3.
5. Consult with the general contractor to determine if SIPS is a viable solution for delay recovery.
6. Finalize SIPS for the UPMC Passavant Pavilion.

Expected Outcome

It is expected that the SIPS developed for the 4th through 6th floor of the Pavilion will generate at least a moderate time savings as compared to the original schedule. These time savings will be realized through the elimination of inefficiencies within the original work flow and planning process. Once the savings are determined they can be compared to any delays which may have occurred on the Passavant Pavilion site during the course of construction. This will be the final determination of whether or not SIPS are indeed a viable option for the remediation of schedule delays.

Analysis 5 – Infection Control Risk Assessment Requirement Investigation

Problem Statement

When evaluating the extent of ICRA levels required to renovate spaces within an existing healthcare facility it is essential to pair the proper level of protection to the critical nature of the space in question. While a lobby may only require a plastic drape for the duration of the renovation a sterile corridor outside of operating rooms requires must more stringent measures and justifiably so.

While the construction documents may specifically identify the level of ICRA which is required for the specific location in question it is important to investigate the requirements to determine if the appropriate level is being utilized. If a blanket ICRA requirement is used for the whole project cost and time savings may be realized by varying the requirements based on the implementation of the proper ICRA level.

Goal

The goal of this analysis is to determine if the ICRA levels shown within the construction documents are not above and beyond those required by UPMC and the Pennsylvania Department of Health (DOH). It is also a goal to create an implementation plan in which the correct ICRA level is used for each space within the renovation areas of the existing hospital facility. Part of this goal is to also generate cost and time savings from this implementation plan.

Research Steps

1. Compile relevant ICRA information from UPMC and the DOH.
2. Contact UPMC to receive input on their requirements for ICRA.
3. Conduct thorough review of the construction documents and identify the ICRA levels required for each portion of the renovation.
4. Determine the ICRA levels required by the information gathered in step 1.
5. Compare the ICRA levels from step 3 and 4 and determine which should be utilized.
6. Generate potential cost and time savings from the differences noted in step 5.
7. Generate new ICRA implementation plan.

Expected Outcome

From this evaluation it can be expected the final determination is that UPMC and Burt Hill incorporated the correct level of ICRA into the renovation plans for the Passavant Pavilion and Addition project. In the situation that there are differences between what is required and what is specified it can be expected that cost and time savings will be generated. Utilizing an ICRA level above what is required can increase the cost and time demands of the construction process through decreased productivity and more complex planning methods.

I also expect to expand my knowledge in ICRA requirements so that I can be a better asset to the project team should I be involved in the construction and/or renovation of a healthcare facility in my future employment.

Conclusion

Through the analysis described above I hope to successfully complete a thorough construction management investigation of the UPMC Passavant Pavilion and Addition. This proposal serves as a framework for my thesis reach that I will conduct during the Spring 2009 Semester. This project is the culmination of the 5 years of study I have completed in the Architectural Engineering program at the Pennsylvania State University. As such I hope to showcase all that I have learned during my studies, as well as, expand my professional knowledge into area which will aid in my success as I enter the construction industry.

Weight Matrix

Description	Research	Value Engr.	Const. Rev.	Sched. Red.	Total
Mobile IT Documents	20%	--	--	--	20%
Precast vs. Brick Veneer	5%	5%	10%	5%	25%
Site Congestion	--	--	--	10%	10%
SIPS	--	--	--	15%	15%
ICRA	10%	10%	--	10%	30%
Total	35%	15%	10%	40%	100%

Appendix A – Breadth Studies

While completing the in depth construction management analyses for the UPMC Passavant Pavilion and Addition I plan on also investigating other areas of the Architectural Engineering discipline. These breadth studies will be part of a larger construction management investigation and they are briefly explained below.

Structural Breadth

My proposed structural breadth is a portion of a larger construction management investigation in which I propose to use precast concrete sandwich panels in lieu of hand laid brick veneer. When determining if this alternate system is a viable option it is important to investigate the structural details that may need to be changed. The brick relief angles that are currently designed will need to be evaluated to determine if they can be utilized for the precast wall panels. If they cannot be utilized a new detail will need to be produced along with any additional connection details that are needed for the system.

Building Enclosure Breadth

From the same detailed construction management analysis outlined in the structural breadth I also plan on completing a building enclosure breadth. Within this analysis I will explore the thermal efficiencies of each system and determine what implications, if any, they will have on the overall integrity of the building enclosure. It would also be necessary to examine the interfaces between the two proposed systems and the other components of the building enclosure to determine any advantages or disadvantages for using each system. While studying the interfaces between the components of the building enclosure system I will examine the moisture and thermal control requirements and ensure that the system complies with relevant standards.

Appendix B – Thesis Research Time Table

January 2009						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6	7	8	9	10
		Christmas Break				
11	12	13	14	15	16	17
		Conduct Research for Analysis 1 and 5				
		Compile List of Information Needed and Make Appropriate Contacts				
18	19	20	21	22	23	24
		Residential Construction Management Competition				
		Las Vegas, Nevada				
25	26	27	28	29	30	31
		Compile Information for Analysis 2 (Continue Research for Analyses 1 and 5)				
		Research Building Enclosure Systems – Begin Structural Detailing Redesign				

February 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
	Continue Analysis 2 (Finalize Research for Analyses 1 and 5) Begin Building Enclosure Analysis – Complete Structural Detailing Redesign					
8	9	10	11	12	13	14
	Continue Analysis 2 – Complete Building Enclosure Analysis Begin Analyses 3 and 4 – Compile Relevant Information					
15	16	17	18	19	20	21
	Continue Analysis 3 and 4 Examine Site Utilization and Deliveries – Develop SIPS Schedule					
22	23	24	25	26	27	28
	Complete Analysis 3 and 4 Review Analyses 1 and 5 to Ensure Completeness					

March 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
	Review of Construction Management Depth Analyses					
8	9	10	11	12	13	14
		Spring Break				
15	16	17	18	19	20	21
	Complete Review of Construction Management Depth Analyses Review Breadth Analyses					
22	23	24	25	26	27	28
	Compile Individual Analysis Reports - Integrate Into Final Report Develop Presentation					
29	30	31				

April 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8 Final Summary Reports Due 5 PM	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Finalize Report and Presentation

Presentation Preparation

Faculty Jury Presentations