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Project 2012

Thesis Proposal

Susquehanna Patient Tower Expansion

Williamsport, PA

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Executive Summary

This ***Thesis Proposal*** is a comprehensive report that investigates the difficult construction parameters associated with the Susquehanna Health Patient Tower Expansion. This 243,000 SF expansion to the Williamsport Hospital and Medical Center is a unique project that presented its own set of difficult problems which tested the construction manager as well as the design team. Hospitals are extremely sensitive places that demand the greatest level of care when operating in and around them. The location of this project is one of the main factors that decided not only how it would be constructed, but also how it would be designed. It is the goal of this report to analyze the construction challenges established in ***Technical Assignment 3*** and to provide solutions that will be examined in the ***Final Thesis Assignment.***

ANALYSIS 1: SHIFT FROM MOBILE CRANES TO TOWER CRANE

This project utilized two different types of mobile cranes to erect the structural steel and the precast panels. These cranes produced much inefficiency that lead to a lack of production. Established early on in the project the watertight milestone was the biggest risk to the schedule and the entire project. For this analysis a tower crane will be utilized to determine if it is a more effective way of erecting the superstructure and thus hitting the watertight milestone. It is the main goal of this analysis to accelerate the schedule and turn the building over to the owner quicker than originally planned. Time willing, an additional comparison will be done involving the use of an extra mobile crane during the structural steel and precast phases of the building.

ANALYSIS 2: USE OF PREFABRICATION FOR QUICKER COMMISSIONING

Analysis two will represent the majority of my ***Final Thesis Assignment.*** During the 2010 PACE Roundtable Conference, Professor Bechtel brought up the new trend of preconstruction within healthcare facilities. More specifically he brought up how Skanska prefabricated entire patient rooms to accelerate the schedule of the project. This analysis will look at the feasibility of using prefabricated rooms to accelerate the schedule and thus achieving the critical commissioning milestone. After developing the time matrix found in ***Appendix A***, it is clear that this analysis will be very heavily dependent on research and relying on industry leaders to provide me with adequate information.

ANALYSIS 3: SIMPLIFYING THE FAÇADE TO REDUCE COST

The Susquehanna Health Patient Tower Expansion project incorporates five different types of façade into its design. Utilizing this number of facades increases the overall project cost and provides many coordination issues as well as site logistical complications. As with all non-profit organizations, funding becomes especially difficult when expanding their operations and facilities. Because L.F. Driscoll has done little value engineering on this project, it is my opinion that the façade is a prime candidate for cost reduction. The two façade systems that will be investigated are the metal panel and architectural precast with brick veneer systems. These systems have been chosen due to their aesthetic similarities and their problems in the field.

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Project Background

Susquehanna Heath is a three-hospital system that hasn't had a major renovation or construction project within the last 20 years. The patient tower expansion project is the fourth phase of Susquehanna Health's Project 2012 initiative. This $250 million initiative was launched in 2006 with the intent to update and renovate the outdated existing facilities as well as clean up the surrounding community. It is Susquehanna's vision to be up-to-date medical facility as well as being a beacon of healthcare.

Designed to be the entrance for Williamsport regional medical center, the new patient tower faces and overlooks the city. This design shows how much Susquehanna Health cares about the community because in previous years the building had pointed away from the city almost shunning it. The building was designed to become a visible landmark and to reach out to the community. This six-story 243,000 square foot tower features 84 single-occupancy rooms, increase privacy, and improved patient care. Private rooms provide an environment in which confidential patient history information is easily accessed and enables the isolation of patients to prevent transmission of infection.

The patent tower also features a two-story entrance for expanded emergency and imaging departments the Second floor houses new intensive care and critical care units and a high-tech education and innovation center. The third floor is comprised of surgical areas with new operating rooms. The fourth floor on the other hand houses orthopedics and spine research and surgical areas.

The building enclosure consists of many different components that make up the building's façade and roof. As seen in the ***Figure 1*** below, the white towers of the façade are constructed out of patterned precast concrete. The south façade is also constructed out of architectural precast concrete however, this façade consists of a thin brick faced precast as well as 3" foam insulated core metal panels. Another

Figure 1: South Rendering of Patient Tower Expansion
Figure Provided By L.F. Driscoll

integral part of the building's enclosure is the curtain wall which can be found on the eastern entrance of the south facade. The curtain walls in conjunction with the many windows which encompass the entire building, serve the vital function of providing natural light to the patients.

ANALYSIS #1: SHIFT FROM MOBILE CRANES TO TOWER CRANE

Problem Identification

As identified in ***Technical Assignment 3***, the most critical target for the project's schedule was the watertight milestone. This problem was especially difficult because the patient tower expansion incorporates many different types of façades. Two different mobile cranes were used on this project and were critical to hitting the watertight milestone. The first mobile crane was a 165 ton Demag AC 120 mobile crane that erected all of the structural steel. A delay in hitting the structural steel top out milestone would then delay the façade. Even though this project has five different facades, the precast panels represent the majority of the building's skin. The second crane, a 240 Ton Liebherr LTM 1200-5.1, was used to erect all precast panels. Due to the limited picking ability of these cranes they had to be continuously moved from one location to another. In addition to moving these cranes around, limited picking ability also complicated the site logistics of the project and forced the project team to close Walnut St. These inefficiencies lead to a decrease in production as well as increase in schedule.

Research Goal

The goal of this analysis will to be to investigate the production, cost, schedule, and site logistic impacts associated with utilizing a tower crane instead of the two mobile cranes. Additionally the cost impacts associated with the tower crane will be cross referenced with the expected faster building turnover date.

Methodology

- Determine what size of tower crane must be used to make all picks
- Determine where to place tower crane and develop new site logistics plan
- Contact L.F. Driscoll and determine the overall costs of the mobile cranes as well as the tower crane
- Analyze the impacts of man hoist
- Analyze the productivity of the tower crane for both structural steel and precast panels
- Determine the schedule impacts and how they affect the watertight milestone
- Perform cost comparison of predicted expansion income vs. costs incurred with tower crane

Resources and Tools to be Used

- L.F. Driscoll Project Management Team: Williamsport and Hershey Teams
- AE Faculty
- Tower Crane Subcontractor-To be determined
- Applicable literature

Expected Outcome

After extensive research, it is believed that utilizing a tower crane instead of the mobile cranes that the overall superstructure schedule will accelerated. This acceleration will then lead to the construction team hitting the watertight and turnover milestones sooner. It is also believed that the tower crane will simplify the site logistics. However, it is predicted that these impacts will significantly increase the overall cost of the project.

ANALYSIS #2: USE OF PRECONSTRUCTION FOR QUICKER COMMISSIONING

Problem Identification

In addition to the water tight milestone, commissioning was also considered another major risk to the schedule. This long and drawn out process happens at the completion of each floor. Before the building could be fully turned over, final commissioning of the whole building had to take occur. Not hitting this date could would lead to serious delays. Because this activity happens at the completion of each floor and at the end of the project, nothing could be done afterwards to fix the schedule.

Research Goal

The goal of this analysis is to accelerate the schedule of each floor by prefabricating typical rooms within the hospital. It is the hope that prefabrication will then allow for commissioning to take place sooner than originally proposed by L.F. Driscoll. Prefabricating entire rooms was critical industry issue proposed by Professor Bechtel at the 2010 PACE Roundtable conference. In addition to schedule acceleration, it is also the goal of this analysis to reduce the overall cost of the project.

Methodology

- Contact Skanska and establish the parameters they used for prefabricating rooms on their hospital projects
- Interview L.F. Driscoll to see if they have ever performed prefabrication of this magnitude
- Compare project parameters of the patient tower expansion with those of Skanska's project
- Research nearby prefabrication shops. If none are present then establish where these rooms are to be built on site and develop site logistics plan
- Re-sequence activities to allow for prefabricated rooms to be placed
- Develop new critical path
- Determine impacts to cost, schedule, and site logistics
- Perform an income evaluation of the expansions new turnover date
- Interview owner and evaluate whether or not this analysis would be favorable.

Resources and Tools to be Used

- L.F. Driscoll Project Management Team
- Skanska Project Management Team if available
- AE Faculty
- Industry Professionals
- Applicable literature on prefabricated rooms

Expected Outcome

Out of all the other analysis', it is believed that this one will be the most in-depth and time consuming. The expected outcome of this analysis is that it should accelerated the schedule by a significant amount. At this point in time it is too early to predict whether or not prefabrication will reduce the overall cost. However, it is also expected to develop new site logistical challenges not in the original scope of work.

ANALYSIS #3: Value Engineering Green Roofs To A Standard Roof With PV Panels

Problem Identification

As established in ***Technical Assignment 3***, very little value engineering was done on this project. This poses a problem because Susquehanna Health is a non-profit organization that relies much of its funding through government agencies as well as public donations. ~~To make things worse this project incorporates many different types of expensive facades. Having additional trades on the project also increases the risk of site congestion as well as the potential of subcontractors not performing to their contract obligations.~~ As stated earlier this project incorporates Green Roofs in its design. However, Green roofs are expensive and do not offer much return for the upfront costs associated with them. Two of the major goals of this project are to meet LEED Certification for Hospitals and to reduce the large operational costs associated with hospitals. The Green Roofs satisfy the LEED goals but do little in the way of reducing the operational costs.

Research Goal

~~It is the goal of this analysis to value engineer both the metal panel system as well as the architectural precast with brick veneer. These systems provide very similar aesthetic features and are located adjacent to each other. Through replacing one with the other, it is the overall goal of reducing the cost of the building as well as the potential for site congestion and poor subcontractor performance.~~

It is the goal of this analysis to value engineer some of the Green Roofs and reduce the overall cost of the roof system. In lieu of the green roof, a standard roof with PV panels will be substituted in its place. Through replacing the Green Roof, it is the overall goal of this analysis to achieve LEED points while reducing the operational costs of the hospital.

Methodology

- Obtain cost information for existing roof system
- Research and contact PV panel manufactures
- Evaluate which Green Roofs should be value engineered
- Determine the amount of panels that can be installed and the energy that they will produce
- Analyze the structural and electrical impacts of standard roof with PV panels vs. the original design
- Analyze where PV panel equipment should be installed
- Analyze potential drainage impacts
- Analyze architectural impacts of the PV panels
- Research Government incentives and rebates
- Perform a cost analysis, feasibility analysis on life-cycle cost, and payback period
- Determine LEED points and interview Susquehanna Health

Resources and Tools to be Used

- L.F. Driscoll Project Management Team/Estimators
- Granary Associates
- Susquehanna Health
- PV Panel Manufactures

Expected Outcome

This analysis will provide both pros and cons for each system. It is believed that replacing the Green Roofs with standard roofs will reduce the weight and cost of the of the roof system. However, adding the PV panels will result in a higher upfront cost than the Green Roof but will ultimately be more feasible over the life-cycle of the building. It is also believed that this new design will decrease the energy dependency of the building while satisfying both LEED objectives as well as reducing the operational costs.

ANALYSIS WEIGHT MATRIX

The weight matrix shown in ***Table 1*** is a preliminary analysis of how each one of the four investigations topics will be distributed throughout the Final Thesis Report. Also included in ***Table 1***, is an analysis of how each investigation will be broken up and how time and resources will be allocated.

Description	Research	Value Engineering	Construction Review	Schedule Reduction	Total
Crane Analysis	5%		15%	20%	40%
Prefabrication	20%		10%	10%	40%
PV Panel VE		20%			20%
Total	25%	20%	25%	30%	100%

Table 1: Weight Matrix for Distribution of Core Areas of Investigation

Timetable

Table 1 has established the overall scope of work and work distribution for the spring semester. To ensure that these goals are met a preliminary timetable has been established for next semester. See Appendix B for the spring semester.

Conclusions

The Susquehanna Health Patient Tower project is a unique project that has challenged the construction management team as well as the design team. This project is heading in the right direction to be one of the premier hospitals of Pennsylvania. Although the construction team has done a great job in managing the project, it is the goal of this thesis to pick up where they left off and improve on the many processes in which they have instilled. Many of the improvements proposed by this thesis are geared toward schedule acceleration and delivering the project ahead of schedule. It is believed that the crane analysis will ultimately lead to faster and more cost effective superstructure erection. Prefabricating typical patient and conference rooms is also another method that this thesis will employ to accelerate the schedule as well as reduce the overall cost of the project. It is also believed that more value engineering should be done on this project to decrease its energy dependency. It is the goal of this analysis to reduce the life-cycle cost of the building. It is hoped that this particular analysis will benefit not only the owner but also L.F. Driscoll.

This proposal is intended to be a working submission with revisions expected based on feedback from the AE faculty and thesis consultants.

Appendix A: Breadth Topics

Breadth Topics

To satisfy all ABET accreditations and fulfill the Architectural Engineering Department's senior thesis requirements, the following breadths not within the Construction Management curriculum will be explored. These breadths will establish that that I am proficient in other areas than simply Construction Management.

Structural/Architectural Breadth: *Contributes to Technical Analysis 3*

~~The value engineering of façade in this analysis will lead to either precast panels being installed where metal panels once used to be or metal panels taking the place of the where precast panels were originally designed for. Either way there will be significant alterations to the structural load that the building will have to carry. Beams, girders, and columns that once carried the old load will now have to be re-examined and possibly redesigned to ensure that they can carry the new load. After completing the value engineering analysis and selecting the replacement facade, the new design parameters will first have to be determined. After new parameters have been established the new loads can then be calculated.~~

The value engineering of the roof systems in this analysis will lead to completely different loads carried by the steel beams and columns. The standard roof will be lighter than the original Green Roofs. However, with the addition of PV panels and supporting equipment the loads will increase in certain areas of the building. Beams, girders, and columns that once carried the old load will now have to be re-examined and possibly redesigned to ensure that they can carry the new load. After completing the value engineering analysis and selecting the replacement roof system, the new design parameters will first have to be determined. After new parameters have been established the new loads can then be calculated.

Because the appearance of the building is being altered a brief architectural breadth will also have to be performed to ensure that the function and overall aesthetics of the building are intact. In addition, Green Roofs critical to patient views will have to be considered.

Renewable Energy/Electrical Breadth: *Contributes to Technical Analysis 3*

~~Whenever materials are altered in a building's façade, there is a good chance that there will be a significant impact to the thermal conductance. Altering the thermal conductance of a hospital can be a dangerous game. Hospitals are sensitive places that cannot afford the temperature of certain areas to be fluctuating. In this analysis all thermal conductivity changes due to the replacement system will be calculated. In addition to this analysis, it will also be imperative to calculate the heating and cooling loads before and after the change to ensure that the owner is being delivered a quality product.~~

The power distribution system for the Susquehanna Health Patient Tower Expansion is a 3-phase 480Y/277 4-wire 15KV feed that runs off of a 12.7 KV transformer. In addition, the entire expansion as well as the existing hospital will be backed up by two diesel powered generators located in the central utility plant.

To decrease the operational costs over the life-cycle of the building, PV panels will be implemented to harness the solar radiation to produce electricity and decrease the energy needs of the building. Electrical equipment in the original design will have to be altered to facilitate the new PV panels and their supporting equipment. Tie-in locations will have to be established and may have run back to the central Utility Plant.

After all data on the electrical requirements of the PV system have been calculated a constructabity review will have to be done to ensure that the systems are compatible. In the event that they are not compatible, a suitable system will be provided.

Appendix B: Spring Semester Preliminary Timetable