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Executive Summary

The Thesis Proposal addresses the various technical areas that I have proposed to research and analyze in more detail. The following report gives a brief summary of the four topics that I plan to focus on for my thesis project. For each analysis, a brief description is provided about the topic and how it relates to the Women's Center and Inpatient Tower. Along with the issues that I have identified, there is also a stated goal for the analysis, techniques for how I plan to develop this topic, and the results that I expect from the analysis. The Weight Matrix at the end of this report shows the breakdown of how I plan to investigate each of these issues.

The first technical analysis looks at developing a process for using 4D Modeling as a comparison tool. The research will focus on developing 4D Models for the other two analysis areas and using this tool to compare the schedule durations and sequences of the two systems. The process is created to make it easier to compare the schedule durations and sequences of alternative systems.

The second technical analysis focuses on using an alternative structural system for the area above the existing mechanical room. The proposed change for this area of the building is to replace the precast concrete panel flooring with a composite metal decking and concrete slab flooring system. The analysis will look at the structural design, the cost impact of the change, and the schedule impacts.

The third technical analysis concentrates on using an alternate façade system for the building. The proposed idea is to look at replacing the EIFS Panels with the original design using GFRC Panels. The analysis will focus on the quality of the two systems along with the cost comparison of the two systems.

Technical Analysis 1
4D Modeling as a Comparison Tool

Problem Statement

Even though 4D Modeling is becoming more prevalent in the building industry primarily within the construction aspect, there are still many obstacles for properly using and understanding the 4D Modeling tool. Because 4D Modeling is a fairly new idea used in the construction industry, many are still learning the basics about what can be done with 4D Modeling. As more of the industry becomes familiar with the idea of 4D Modeling, the next step will be how to properly use the tool. Many believe that 4D Models can only be used to show a construction sequence; however, there are many other uses for 4D Modeling. One area that proves to be useful for the BWMC- Women's Center and Inpatient Tower is using 4D Modeling as a comparison tool between two systems. By developing a process that provides a clear description on how to compare systems using 4D Modeling, many project teams will be able to compare alternative systems during the value engineering process.

Goal

The goal for developing a 4D Modeling process is to show the benefits of using a 4D Model as a comparison tool when looking at alternative systems. The analysis will first look at developing a 3D model of the Women's Center and Inpatient Tower. The 3D Model will be used to compare the other two analysis areas within my thesis project. The process for developing and using a 4D Model as a comparison tool will first be documented and then will be reviewed through my other two analysis areas. The 4D model will be used to review both the structural alternative and façade alternative that were chosen for the two other topics. In order to show the differences in sequencing and durations, the sequencing for the two systems will be illustrated on a single model. By showing the sequencing on a single model, the system that finishes first can easily be determined. If the 4D Model would have been developed and used on the Patient Tower, it would have made the comparison between systems' durations much easier. The use of the 4D Model on the project may have also led to different decisions on the structural system and façade system.

Research Steps

1. The first step to this analysis is to develop a 3D Model.
2. Create a CPM schedule in Microsoft Project.

Technical Analysis 1
4D Modeling as a Comparison Tool

3. Link 3D Model and CPM schedule in Navisworks Timeliner
4. Simulate the construction sequencing for the two systems using a single model.
5. Review the simulation process and develop conclusions.
6. Repeat steps 2-5 for the second analysis area.
7. In order to develop a clear and concise process for using 4D Modeling as comparison tool, various areas on 4D Modeling where processes have been developed need to be researched. The research will focus on how to develop an effective description of the process used.
8. Document the process of creating and utilizing a 4D Model as a comparison tool.
9. Document the lessons learned with using a 4D Model.
10. Receive feedback on the process and case studies and make any changes necessary.
11. Finalize the analysis area.

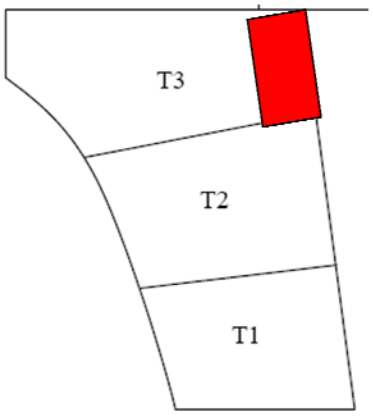
Expected Outcome

The expected results of this research is to provide an easy-to-follow process for using 4D Modeling as a comparison tool. Because 4D Modeling is an evolving technology, there are still a lot issues with the tool that need to be worked out. Therefore, this process for using 4D Modeling as a comparison tool does has some flaws. By finding effective ways in which the 4D Modeling tool can be used, the process for implementing and using the tool will be much smoother for companies.

Technical Analysis 2
Precast Concrete Planks vs. Cast-in-Place Concrete

Problem Statement

The structure for the Women's Center and Inpatient Tower is primary a cast-in-place concrete system; however, part of the structural system is composed of structural steel framing with precast hollowcore concrete panels. Because part of the new patient tower is being built over-top of an existing mechanical room, a structural steel truss system was used in this area to support the patient tower. The steel framed truss supports the area above the existing mechanical room for levels three through eight and the penthouse level. For this area, precast hollowcore concrete planks were used for the flooring of the structure. The technical analysis will look at eliminating precast hollowcore concrete planks from this area, and using composite metal deck with cast-in-place concrete for the flooring system. This analysis will focus on the cost impact, schedule impact, and constructability. To determine the cost impact of changing the structural flooring system, the cost of using cast-in-place concrete would be compared to the cost of precast concrete planks. Along with the cost impact, a constructability review will be performed to ensure that the change in flooring will be structurally sound. The review will consist of an analysis of the structural performance of the composite decking and slab. This analysis will then be compared to the precast concrete planks performance. The review will also look at the various challenges that may exist for constructing each of the structural systems. The change from precast concrete planks composite metal decking and slab may also have an impact on the project schedule. The change from precast hollowcore concrete planks to composite metal decking with concrete slab will potentially reduce the project schedule duration for the structural system of the patient tower. Because cast-in-place concrete is used for the rest of the tower, the time required to get the concrete is minimum. By using cast-in-place concrete, the concrete planks will be eliminated; therefore, the time needed to order and deliver the planks can be reduced. With cast-in-place concrete, the slabs in this area can be poured with the rest of the slabs for the tower whereas the precast planks would only be placed later in the process.



Plan View of Patient Tower

Technical Analysis 2
Precast Concrete Planks vs. Cast-in-Place Concrete

Goal

The goal of this technical analysis is to demonstrate that cast-in-place concrete flooring can be used as a viable option for the area above the existing mechanical room. By using the cast-in-place concrete, the precast concrete can be eliminated from the entire project. The costs of the precast panels will be removed from the project budget, and the costs of the metal decking and additional concrete will be added to the budget. The costs of the composite metal decking and slab will be somewhat lower than the cost of precast panels; therefore, the overall project budget will be somewhat reduced. Because the cast-in-place concrete will be placed along with the rest of the levels, the schedule will be simplified, and hopefully reduced. In order to illustrate the schedule for the cast-in-place system, a 4D model will be created. This technical analysis will be used as my structural breadth for my thesis research.

Analysis Steps:

1. Compile all information that corresponds to the steel truss and precast concrete panel structural system. This information will include the original budget and the project schedule.
2. Details pertaining to the construction of the precast panels and a description of the precast panels will also be reviewed. This may include any issues that occurred with placing the precast concrete panels.
3. Discuss the structural design with structural professors and students.
4. Design and analyze the composite metal decking and concrete slab system.
5. Create a schedule and budget for the alternate system.
6. Develop a 4D model to illustrate the schedule sequencing.
7. Compare the costs and durations of the alternate system to the original system.

Expected Outcome

The expected results for this technical analysis is to show the many advantages of using composite metal decking and concrete slab over the precast concrete panels. For this analysis, the composite slab system is expected to be a lower cost alternate to the precast panels. The time duration for procuring and placing the alternate system is also predicted to be less than the original system. These advantages will be demonstrated through the budget and schedule comparison. The 4D model will also display the scheduling advantage of the composite slab verses the precast panels. Through this analysis, hopefully it will be apparent that the alternate system is the best solution for this particular area of the building.

Technical Analysis 3
EIFS Panels vs. GFRC Panels

Problem Statement

The original design of the Women's Center and Inpatient Tower included Glass-Fiber Reinforced Concrete (GFRC) Panels for the majority of the façade. During the value engineering process, these panels were replaced with Exterior Insulation Finishing System (EIFS) Panels. During the construction of the building façade, there have been a few problems with EIFS Panels. The problems with the EIFS have delayed the project schedule, which may have an impact on the project cost. Along with this issue, there is also concern about the quality of the EIFS system. If EIFS is not properly installed, there is the potential that water will seep into the building, and there will be mold issues. Because this building is a hospital, it is crucial that the building is of the highest quality; therefore, any health issues such as mold need to be avoided at all costs.

Goal

The goal of this technical analysis is to prove that the advantages of the original design far outweigh the advantages of the EIFS Panels. Because the highest quality needs to be maintained for hospitals, this analysis will look at the quality of the two façade systems. The analysis will also look at the constructability of the two systems, which will ultimately affect the durations. The advantages of the GFRC Panels will be demonstrated by improving the installation process of the façade system, which will decrease the schedule duration and also by improving the indoor quality of the hospital.

Analysis Steps:

1. Compile all information that corresponds to the EIFS Panels. This information will include the original budget, project schedule, and any issues with the EIFS System.
2. Obtain information about the GFRC Panels and also the EIFS Panels from various manufacturers.
3. Compile and compare the information for the two systems.
4. Analyze the structure and support system for the GFRC Panels.
5. Create a schedule and budget for the alternate façade system.
6. Compare the costs and durations of the GFRC Panels to the EIFS Panels.

Technical Analysis 3
EIFS Panels vs. GFRC Panels

Expected Outcome

Through this analysis, it is expected that the GFRC Panels will be the best solution for the façade system. Even though the GFRC Panels may prove to be a more expensive alternative, it is predicted that the system will still be the best value system for the hospital. The quality of these panels will outweigh the extra costs that may be incurred for the GFRC system. The schedule duration for the GFRC Panels is also predicted to be shorter than the EIFS Panels. Through the comparison of the two systems, hopefully it will be obvious that the GFRC Panels are the best alternative for the façade system.

Weight Matrix

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
4D Modeling	10%			20%	30%
CIP vs. Precast		10%	10%	10%	30%
EIFS vs. GFRC	10%	10%	10%	10%	40%
Total	20%	20%	20%	40%	100%

Appendix A
Thesis Breadths

The Thesis Proposal addresses the two breadths that I have proposed to research and analyze in more detail. A brief description is provided for each breadth that I plan to analyze for my thesis project on the Women's Center and Inpatient Tower.

Structural Breadth

The first breadth is to use an alternative structural system for the area above the existing mechanical room. The proposed change for this area of the building is to replace the precast concrete panel flooring with composite metal decking and concrete slab flooring system. The breadth will focus on redesigning the structural flooring system for this area.

Building Enclosure Breadth

The second breadth is to use an alternate façade system for the building. The proposed idea is to look at replacing the EIFS Panels with the original design using GFRC Panels. The breadth will look at the quality of the system to protect against weathering and also the architectural appearance of the GFRC Panels.