Central Bed Tower Expansion

University of Virginia | Charlottesville, VA

Thesis Proposal

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Executive Summary

The following proposal is intended to be an overview of the research analyses to be performed for the UVA Hospital Bed Expansion. The four analyses topics include Prefabricated Acoustical Walls, BIM Implementation, Photovoltaic (PV) Façade Change, and Prefabricated MEP Systems.

Analysis #1 – Schedule Reduction Via Prefabricated Acoustical Walls

The Hospital Bed Expansion is combining new construction with renovations throughout the existing hospital. With these renovations come noise and vibration restrictions that dictate the construction schedule in the designated areas so as to prevent excessive disturbance to patients and visitors. The goal of this analysis is to perform a preliminary design of a vibration control and acoustical barrier wall system and analyze the schedule impacts of reorganizing construction activities to create the most efficient work schedule for this renovation area.

Analysis #2 – Schedule Reduction Via BIM Implementation

Major delays have affected The Hospital Bed Expansion. Unforeseen conditions and owner delays have postponed the substantial completion by four (4) months. Rather than finishing by December 2011, the new substantial completion is April 2012. The goal of this analysis is to create a 4D phased model that will assess the efficiency of a phased construction schedule. This analysis also has the goal of researching 3D laser scanning technologies (for existing conditions) to assess the constructability, schedule, and cost benefits.

Analysis #3: Energy Design Study Through Photovoltaic Façade Change

The Hospital Bed Expansion features a North Facing 17,500 ft² glass façade, and although this façade may be aesthetically pleasing while contributing day-lighting to the patient rooms, there is concern over both the consequential mechanical loads and the potential lack of patient privacy that ensues glass facades. The goal of this analysis is to perform a preliminary redesign of the glass façade and assess the effects on electrical, mechanical, and structural loads.

Analysis #4: Schedule Reduction Via Prefabricated MEP Systems

A popular method to help reduce the schedule is prefabrication. Because the hospital is being constructed as a structural steel system, prefabricated modular rooms would be impractical to use despite the repetitive floor layout. However, there are smaller assemblies that can still be manufactured as prefabricated systems. The goal of this analysis is to reduce the construction schedule by simplifying the process of fabricating and installing the major MEP and Telecommunications systems.

Included in this proposal is a weight matrix detailing the amount of time and effort expected to be spent on each analysis. Also included is a schedule that outlines the expected work timeline and milestones to be attained during the Spring Semester.

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Project Background

The University of Virginia Health System is expanding their hospital (the Hospital Bed Expansion) to accommodate the growing needs of the patients, visitors, and employees. With a total of 60,000 square feet of added space and 70,000 square feet of renovated space, the Hospital Bed Expansion will include six occupied floors repetitive in design. Each floor will feature seven patient rooms facing northwest. The 2nd floor is reserved for MEP space and will include a relief air plenum along with a transformer and electrical room. The project also includes the replacement of an existing ballasted Ethylene Propylene Dien Monomer (EPDM) roof with a new Thermoplastic Polyolefin (TPO) roof. An extensive green roof will be installed atop the first floor lobby.

Prior to the structural steel being erected, several existing columns will need to be strengthened. All of these columns exist in occupied areas of the hospital which will require Infection Control Risk Assessment (ICRA) walls to surround the work areas to ensure safety measures for patients are upheld in the hospital. ICRA walls will be required around all renovation areas including the major renovation space and individual waiting rooms which are to be renovated.

Before construction started, the project was already delayed. With the owner taking eight (8) months longer to move out than what was originally planned, the project was slated to have a delay on the substantial completion date. The owner delay along with unforeseen conditions on the existing building has pushed back the substantial date by four (4) months to April 2012 instead of December 2011.

Gilbane/Russell has been hired as a joint venture CM Agent to provide coordination and management services to the UVA Facilities Management team. SmithGroup has been hired solely as the architect via a lump sum contract; SmithGroup will hold contracts with the engineering and consulting firms. The UVA Facilities Management Team is holding a multiple prime contract with the subcontractors who are selected base upon prequalification data and a competitive bid.

The site is a tight area that is limited in space for material storage and parking. The Job Site trailers are located a block away from the actual site due to the congested area. While the Hospital Bed Expansion is being constructed, UVA has also begun the Emily Couric Cancer Center which will be built cattycorner to the current project site. This will complicate the area even more as two construction teams will attempt to keep traffic moving as smoothly as possible while still maintaining an efficient construction site. Gilbane/Russell will assist the project team and help reduce coordination issues.

Within the project site will be located portable toilets, dumpsters and a Manitowoc 888 crawler crane. The site will need to remain clean in order to allow concrete pump trucks, delivery trucks, and other vehicles to access the site safely. In order to create an efficient means of transportation to each floor, a hoist will be erected after the structural steel has topped out and before the glass façade is placed.

The original project cost was around $43 million and has since grown to roughly $55 million due to unforeseen conditions and schedule delays causing an added cost for the added time personnel will need to be on site.

Analysis #1: Schedule Reduction Through Prefabricated Acoustical Walls

Problem Identification

The Hospital Bed Expansion is combining new construction with renovations throughout the existing hospital that include separated waiting rooms and steel column reinforcing. With these renovations come noise and vibration restrictions that dictate the construction schedule in the designated areas so as to prevent excessive disturbance to patients and visitors. Rather than high-noise volumes being the source of work restrictions, the UVA Project Manager expressed concern over vibrations stemming from the equipment being used (pneumatic tightening, hammer drilling, concrete demo, etc.) in the renovation areas. Despite the local regulations providing guidelines for high-level noise and vibration operations in occupied buildings, alternative solutions such as acoustical barriers and vibration controls, have not been addressed in this area of renovation work.

Research Goal

The goal of this analysis is to perform a preliminary design of a vibration control and acoustical barrier wall system and analyze the schedule impacts of reorganizing construction activities to create the most efficient work schedule for this renovation area.

Approach

- Research the type of construction work activities being performed
- Contact Local Regulator for possible solutions to high-level vibrations
- Reschedule the construction activities to group high-noise and vibration operations together
- Consult Acoustical Design Professional about approaches to sound barrier walls
- Design a prefabricated acoustical wall
- Analyze noise volumes between acoustical walls and non-acoustical walls
- Analyze schedule, cost, and constructability of wall system

Resources

- Moses Ling
- UVA Local Inspector/Regulator

Expected Outcome

After extensive research it is expected that a restructuring of the construction schedule in renovation areas along with prefabricated acoustical barrier walls will significantly reduce the project schedule by creating a more efficient timetable. Because the prefabricated acoustical walls will be specially constructed, the initial cost will be higher than non-specialized walls. However, these walls will recover the higher initial cost through the time saving erection process and reusability. This analysis will research the schedule, cost, and constructability impacts along with satisfying an acoustical breadth topic.

Analysis #2: Schedule Reduction Through BIM Implementation

Problem Identification

The Hospital Bed Expansion did not utilize any type of phasing on this project which could be a major factor in the current schedule delays throughout construction. A proper phasing model would have been advantageous in creating deadlines that prioritize construction sequences and owner move-out dates. Unforeseen conditions have also been a challenge in maintaining an accurate schedule. Construction issues arising in regard to existing conditions of the hospital may have been alleviated with the use of 3D laser scanning. Both Phase Modeling and 3D Laser Scanning are subcategories of BIM technologies that if implemented could dramatically improve the project's schedule and reduce the possibility of any delays.

Research Goal

The goal of this analysis is to create a 4D phased model that will assess the efficiency of a phased construction schedule. This analysis also has the goal of researching 3D laser scanning technologies to assess the constructability, schedule, and cost benefits.

Approach

- Interview the Project Manager to determine all contributing factors to project delays
- Request the use of current AutoCad from Architect and Project Owner
- Research the potential of 3D laser scanning
- Create a 3D model of the Hospital Bed Expansion
- Create a phased construction schedule
- Link phased schedule to 3D model
- Test the 3D Laser Scanning method by creating a model (time permitting)

Resources

- UVA Project Management Team
- Penn State AE Faculty
- Navisworks
- MS Project

Expected Outcome

The implementation of BIM modeling is expected to result in the development of a realistic project schedule through the prioritizing of construction activities thus creating a phased schedule. It is believed that these models would create a more efficient construction schedule as thought and planning must be undertaken on all parts of the project management team in order to prepare for unexpected challenges. Along with schedule reduction, this analysis will delve into cost benefits and the potential constructability challenges to be encountered with phased construction.

Analysis #3: Energy Design Study Through Photovoltaic Façade Change

Problem Identification

As mentioned earlier, this project is to feature an extensive green roof to be added atop the main lobby and a Thermoplastic Polyolefin replacement roof for the main hospital tower. These features will help the project team attain a LEED Silver Rating for the Hospital Bed Expansion. This expansion also features a North Facing 17,500 ft² glass façade, and although this façade may be aesthetically pleasing while contributing day-lighting to the patient rooms, there is concern over both the consequential mechanical loads and the potential lack of patient privacy that ensues glass facades. Because the UVA Health System desires to attain a sustainable building, a new façade detail may be worthwhile to investigate. While maintaining the aesthetically pleasing appearance of the current glass façade, a newly popular glazing system has been brought to attention by Penn State AE faculty. A photovoltaic glazing system will retain the same desired façade appearance with the benefit of adding privacy for the patients (through alternate panel transparency) and contributing to the sustainable features of the project.

Research Goal

The goal of this analysis is to perform a preliminary redesign of the glass façade and assess the effects on electrical, mechanical, and structural loads.

Approach

- Evaluate the constructability and schedule on installation of PV Glazing Systems
- Research various designs and costs for Photovoltaic Glazing Systems
- Redesign the façade
- Assess the effects on electrical and mechanical loads
- Assess the effect on structural load (time permitting)

Resources

- Fellow Classmates
- AE 498D – Photovoltaic Systems and Industry

Expected Outcome

After evaluating the effects of a PV Glazing System, it is expected that the new façade design will retain positive aesthetics while providing additional privacy to patients. Although the façade faces north, it is believed that a PV Glazing System will provide enough energy to power a small amount of electricity (such as light fixtures) in each patient room. While these PV panels will help alleviate a small amount of the Hospital's energy consumption, it is not expected to provide support for the mechanical system unless insulated PV panels can be found. Along with cost, and constructability, this analysis will satisfy electrical and mechanical breadth topics.

Analysis #4: Schedule Reduction Through Prefabricate MEP Systems

Problem Identification

As mentioned earlier, the Hospital Bed Expansion has had issues with schedule delays throughout the project. Along with the several other methods mentioned earlier, another way to alleviate the schedule strains is prefabricated systems. Because the hospital is being constructed as a structural steel system, prefabricated modular rooms would be impractical to use despite the repetitive floor layout. However, there are smaller assemblies that can still be manufactured as prefabricated systems. Ductbanks, electrical busways, telecommunications, and various other components are typically run together. These components can be manufactured offsite, where the correct size and length can be fabricated. After each designated component is fabricated offsite, the entire system can be combined and then installed together, potentially simplifying the installation time and process.

Research Goal

The goal of this analysis is to reduce the construction schedule by simplifying the process of fabricating and installing the major MEP and Telecommunications systems.

Approach

- Research the type of labor used on project (Union or Open Shop)
- Determine which components can be fabricated to fit together as an assembly
- Determine who is responsible for installing systems
- Assess the time required to fabricate and then install assemblies
- Evaluate the time and cost savings

Resources

- UVA Project Management Team
- Penn State AE Faculty

Expected Outcome

Upon completing the research of this prefabrication method, it is expected that the cost and time savings will be a benefit to the project. If it is found that unions were used on the HBE project, then this analysis will need to delve into the Project Labor Agreement to find a solution.

Weight Matrix

The following table illustrates the amount of time that is expected to be delegated on each analsysis topic.

Table 1 illustrates the time that is expected to be spent on each analysis topic.

Description	Research	VE	Constructability	Schedule Reduction	Total
Acoustical Walls	5%		5%	10%	20%
BIM Implementation		20%		10%	30%
Façade Change	5%	10%	10%		30%
Prefab Systems			10%	10%	20%
Total	**10%**	**30%**	**30%**	**30%**	**100%**

Spring Semester Student Schedule

Reference Appendix B for a preliminary schedule of the student's expected milestones. Dates are estimated and will vary. This schedule is to ensure that the student will maintain a working timeline to continue research on each analysis topic.

Conclusion

Through in depth research on each analysis topic, it is hoped that these alternative methods will be of some benefit to the current project management team to use in the future. An acoustical wall is expected to ease the work hour restrictions within the hospital walls. BIM implementation will be a benefit to not only the construction team but also the owner and hospital patrons so as to keep them updated via models in real time. A façade change will bring an ease in energy consumption for the new hospital wing but will retain the design integrity by the architect. Finally, prefabrication for mechanical, electrical, and telecomm components will lessen the time required to install the assemblies.

Breadth topics can be found in Appendix A.

Works Cited

Project manager

Hoy, Christopher. Telephone Interview. 10 11 2011.

Faculty Advisor

Dubler, Craig. Personal Interview. 15 11 2011.

Appendix A – Breadth Topics

Analysis #1 – Effects of Prefabricated Acoustical Walls on High-Noise Volumes

Along with the research detailing cost and schedule reduction of acoustical walls, an analysis will be performed on the effects of acoustical walls dampening the high-noise volume operations. Meetings with acoustical designers will be necessary to determine the proper wall design to effectively address the type of construction activities being performed in each work area. After determining the proper wall design, calculations will be performed to assess the effect of acoustical wall chosen. These walls will also be designed as a prefabricated system to allow easy and quick installation.

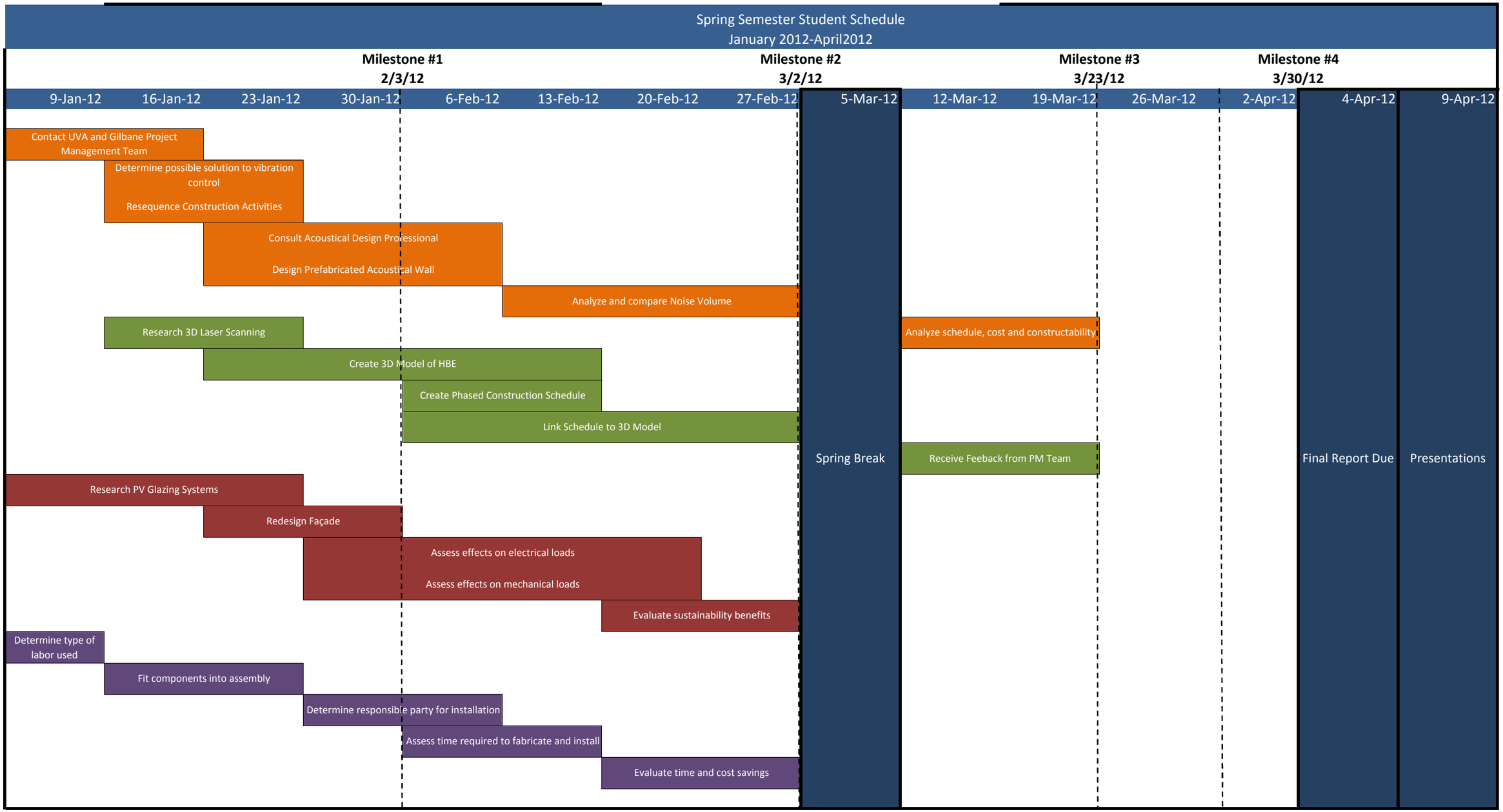
Analysis #3 – Effects of Photovoltaic Glazing Systems on Electrical Consumption

The Photovoltaic Glazing System proposed in Analysis #3 is expected to alleviate the energy consumption in the form of electricity. With the benefit of AE 498D – Photovoltaic Systems, a resource will be available to examine the effects of this system on energy consumption. After the appropriate system is chosen, calculations will be performed to determine the electrical load that can be expected to be contributed through the PVs.

This system is not expected to contribute a significant electrical load to the building; however it is believed that this glazing system will provide enough electricity to power minor appliances in each patient room.

Appendix B – Spring Semester Schedule

Spring Semester Student Schedule
January 2012-April2012



Milestone Activity:
1. Complete all research for analyses
2. Complete Analysis #3 and #4
3. Complete Analysis #1 and #2
4. Finish Final Paper and Presentation

Analysis #1
Analysis #2
Analysis #3
Analysis #4