

Bayhealth Medical Center



Dover, Delaware



Final Proposal

**The Pennsylvania State
University**

**AE Faculty Advisor: Chimay
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**Architectural engineering
senior thesis**

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Construction Management

I. Executive Summary

Senior thesis final proposal is intended to discuss four analyses that will be performed on the bayhealth medical center expansion. Each of the four analyses outlined below were chosen to add quality and value to the building without a large additional cost to the owner. Each analysis will be studied to find their individual impacts to the projects schedule, additional added value to the building, and any constructability issues.

Analysis 1: redesign building envelope

Analysis #1 will be a redesign of the curtain wall system located on the eastern facade of the Bayhealth medical center. The project team has had several issues with getting the current curtain wall system tied into the two other façade systems used, and getting the building water tight.

Analysis 2: Sustainability (green roof)

Analysis #2 will be a look into the addition of a green roof system to the Bayhealth medical center. The feasibility of adding a green roof system to the current structural system, and also to the proposed future additions will be discussed. The advantages and disadvantages to the addition of a green roof system will also be discussed.

Analysis 3: Prefabrication of building systems

Analysis #3 will be a study in the implementation of prefabrication on the Bayhealth medical center. This analysis will determine what areas would be the best to implement prefabrication, and its effects on the schedule, overall cost, and quality

Analysis 4: Implementation of BIM

Analysis #4 will be a feasibility study of the implementation of BIM on the Bayhealth medical center. It will analyze the advantages and disadvantages of using BIM, and the possible schedule and cost impacts.

II. Table of Contents

I.	Executive Summary.....	2
III.	Project background.....	4
IV.	Analysis	5
A.	Analysis 1: redesign building envelope.....	5
B.	Analysis 2: Sustainability (green roof).....	6
C.	Analysis 3: Prefabrication of building systems.....	7
D.	Analysis 4: Implementation of BIM.....	9
V.	Analysis Weight matrix	10
VI.	Time Table.....	10
VII.	Conclusion.....	11
VIII.	Appendix A: Breadth studies.....	12
IX.	Appendix B: Preliminary spring semester timetable	14

III. Project background

The Bayhealth Medical Center is the largest healthcare system in central and south Delaware. It is comprised of Milford memorial hospital, Middletown medical center, and other satellite facilities. The Bayhealth medical center is an expansion to their current facilities located in Dover Delaware. The expansion consists of a 215,000 SQ feet pavilion building which will house a 225 bed patient care tower, an emergency department, oncology (both chemo and radiation), heliport, security, pharmacy, Diagnostic imaging, and shell space. The projected cost of construction to the pavilion building is a GMP contract of 65 million. A four level 270 space parking garage is already erected, and is attached to the pavilion building. A central service facility is also being built that houses all new mechanical equipment. Finally, a bridge connecting the central service building and employee parking lots to the pavilion will be erected. Construction was started on December 24, 2007 and is expected to be completed in May 2012.



Figure 1 courtesy of the Bayhealth medical center

Whiting-Turner was chosen as the General contractor to complete the entire phase 2 expansion. There are currently plans of a future addition of multiple floors to the pavilion building.

IV. Analysis

A. Analysis 1: redesign building envelope

Problem Identification:

The bayhealth medical center expansion's façade is comprised of three different systems: metal panels, masonry brick, and a curtain wall system. Because each of these three types of wall systems has their own manufacture specified waterproofing system, a problem with getting the building water tight was encountered. The main problem found with the façade was tying the curtain wall systems waterproofing into the other two systems.

Research goals:

The goal for this analysis will be to study the current façade and investigate the reason or reasons making it water tight was so problematic. Based on these findings either changes to existing curtain wall system or a new system meeting the same criteria will be proposed. Also because changes to the building's façade will impact the buildings solar heat gain, an investigation into this impact on the buildings mechanical system will be performed.

Methodology:

- Analysis of current façade systems
- Contact manufacturers for design consultation
- Interview project team to discover exact problem encountered
- Analyze cost, schedule, and constructability impacts of new system (if needed)
- Determine impact to mechanical system

Resources that will be used:

- Industry professionals
- Whiting- Turner project team
- AE faculty
- Available literature
- Product manufacture

Expected outcome:

After completing research about the existing curtain wall system, and concluding what changes need to be made, a workable solution will be found and its impacts to cost, quality, and the schedule will be discussed. Also, the solar heat gain of a different curtain wall system will be analyzed and its possible effects on the buildings mechanical system will be determined.

B. Analysis 2: Sustainability (green roof)**Problem Identification:**

There were very few sustainable ideas implemented on the bayhealth medical center expansion. Green roof technology is beginning to emerge in the construction industry today as a way to not only make a building more environmentally friendly, but also as a way to provide savings to the owner in the long run. A green roof system is a great way to reduce storm water runoff, reduce the buildings heat island effect, and reduce mechanical loads.

Research goals:

The goals for this analysis will be to study green roof technology, and then determine its cost effectiveness on this project. The buildings steel structure, both current and proposed addition, will also be studied to determine whether it can support the additional weight of a green roof system.

Methodology:

- Analyze current and proposed steel structure
- Research various types of green roof systems
- Redesign current roof structure
- Discuss with owners rep about future additions
- Determine if a green roof system can be removed after installation and installed again
- Decide upon a way to move the green roof system
- Assess the cost and schedule implications of a green roof addition.
- research other possible sustainable ideas to implement (time permitting)

Resources that will be used:

- AE faculty
- Available literature
- Industry professionals
- Structural drawings

Expected outcome:

With the addition of a green roof system, the overall performance of the building is expected to increase. Because of the already oversized steel structure, it is expected that the superstructure will be able to carry the added weight of the green roof system, with minor modifications to the roof structure. But, there will be impacts to the schedule and total cost of the building that will need to be considered. The negative cost and schedule impacts caused by the addition of a green roof will be offset by the extended lifecycle and overall increased thermal efficiency of the building.

C. Analysis 3: Prefabrication of building systems

Problem Identification:

Because of the extensive amount of MEP systems needed in a hospital, a lot of time and money is spent installing these systems. Since these systems are so important to the overall building, their installation is usually on the schedules critical path. Because cost and quality are paramount to the bayhealth medical center expansion owner, the installation of these systems must be watched over diligently. The installation of these systems is not only time consuming and expensive, but can also be very problematic.

Research goals:

The goals for this analysis will be to determine a potential area of the building to implement prefabrication, and to evaluate the possible time and cost savings to the project. Also, what systems can take advantage of prefabrication will be determined.

Methodology:

- Research prefabrication technologies in the industry
- Identify similar projects that have implemented prefabrication
- Contact industry specialists
- Determine the most effective areas for prefabrication
- Determine what systems can be prefabricated
- Calculate the time and cost saved by prefabrication
- Create a 3D mock-up of a prefabricated systems

Resources that will be used:

- AE faculty
- Available literature
- Industry professionals
- Drawings and specifications
- Revit
- Navisworks

Expected outcome:

After completing the research about prefabrication, it is expected that an ideal area to use prefabrication will be discovered. Also, the prefabricated systems are expected to be a higher quality than the originally proposed installation, and be finished in a shorter period of time. A 3D mock-up will be created, visually showing areas that prefabrication could potentially be utilized.

D. Analysis 4: Implementation of BIM

Problem Identification:

BIM seems to be one of the most talked about topics in the construction industry today. It is completely revolutionizing how construction projects are being done today. Using BIM can greatly reduce the time and money it takes to ensure that building systems can be installed without clashes, and reduce the number of change orders and field problems that occur due to clashes.

Research goals:

The goal of this analysis will be to show how the use of BIM can help streamline the coordination process through identifying areas of MEP construction that could be problematic, before these issues occur in the field, implementing 3 D clash detection, and coordination.

Methodology:

- Review the BIM Project Execution Planning Guide created by Penn State
- Identify similar projects that have implemented BIM
- Research the cost of creating 3 D drawings
- Evaluate the cost and schedule impacts of 3D MEP coordination.
- Summarize the advantages and disadvantages of implementing BIM on a project

Resources that will be used:

- Autodesk Revit & Autodesk Navisworks
- AE faculty
- Available literature
- Industry professionals
- Penn State's BIM Execution Plan

Expected outcome:

The expected outcome will be that BIM can be effectively used on a project of this type, and a cost savings to the owner can be shown. It is also expected that with the use of BIM it can be shown that a project can be streamlined, and a higher quality end product can be achieved.

V. Analysis Weight matrix

The weight matrix shown in figure 2 shows the percentage breakdown of the four core thesis investigation areas. The percentages are an estimate of the work that will be put into each core area.

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Analysis 1		10%	10%		20%
Analysis 2	10%	10%	20%		40%
Analysis 3				10%	10%
Analysis 4	10%			20%	30%
Total	20%	20%	30%	30%	100%

Figure 2: Weight matrix distribution of core areas of investigation

VI. Time Table

In an effort to follow the progression of the proposed analysis in this report, a time table has been created to track overall progress during the spring semester. A preliminary spring semester time table can be found in appendix B.

VII. Conclusion

This report summarizes the key areas of investigation for the duration of this senior thesis. Each of the four analysis's described above will be thoroughly researched and investigated to improve the bayhealth medical center's quality, while potentially lowering its overall cost. The evaluation of the façade will provide a solution to the issue of making the building watertight. The addition of a green roof system will not only add a sustainability aspect to the building, but will also save the owner money in the long run. The prefabrication of the MEP systems will be a way to save time on the project schedule. The implementation of BIM on the project will be a way to streamline the project, and provided the owner with cost savings and high quality.

VIII. Appendix A: Breadth studies

Breadth topics

Structural breadth: contributes to technical analysis #2

The current roof is comprised of a 4.5" thick normal weight concrete slab on an 18 gauge composite metal decking. Roof build up is a tapered 3" rigid insulation covered with a single ply EPDM membrane. As proposed in technical analyze #2, a green roof system will be added to the building's roof.

This analysis will satisfy one breadth requirement, since a structural analysis will be completed for the existing building, and also for the proposed expansion of additional floors. After the structural analysis, any additional support needed will be designed and its added cost and schedule impact will be analyzed. The schedule and cost impact of adding the green roof system to the existing building will also be researched.

Mechanical Breadth: contributes to technical analysis #1

The current façade is comprised of different systems: metal panels, masonry brick, and a curtain wall system. Because each of the three types of wall systems has their own manufacture specified waterproofing system an issue with getting the building water tight was found. The issue was found to be with tying the curtain wall system into the other two facades. As proposed in technical analyze #1 a different curtain wall system will be proposed.

This analysis will satisfy one breadth requirement since, in technical analysis #1, an analysis will be performed on the impacts to the mechanical system from the new curtain wall system. After the load impact to the mechanical system from the new curtain wall system have been established, the mechanical system will be resized accordingly. The cost, constructability, and possible savings to the owner will be investigated.

IX. Appendix B: Preliminary spring semester timetable

Proposed Thesis Semester Schedule

			Milestone 1	Go-No Go Check	Milestone 2	Milestone 3					Presentation Check									
			1/29/11		2/17/2011	3/5/2011					Milestone 4									
1/9/2011	1/16/2011	1/23/2011	1/30/2011	2/6/2011	2/13/2011	2/20/2011	2/27/2011	3/6/2011	3/13/2011	3/14/2011	3/20/2011	3/27/2011	4/3/2011	4/10/2011	4/17/2011	4/24/2011				
Analysis of current façade systems								S p r i n g B r e a k					F i n a l R e p o r t D u e 4 / 7 / 1 1	F a c u l t y J u r y P r e s e n t a t i o n s	A B E T A n a l y s i s / C P E P U p d a t e	S e n i o r B a n q u e t A p r i l 2 9				
	Contact manufacturers for design consultation																			
	Interview project team to discover problem encountered																			
	Determine impact to Mech system																			
	Review the BIM Execution Planning Guide by PSU																			
	Identify similar project that has implemented BIM																			
	Research the cost of creating 3 D drawings																			
	Evaluate the cost and schedule impacts of 3D MEP coordination.																			
	Summarize the advantages and disadvantages																			
	Analyze current steel structure																			
	Research various types of green roof systems																			
	Discuss with owners rep about future additions																			
	Determine feasibility of moving green roof									green roof										
	Redesign roof structure									green roof										
	Find a way to move the																			
	Find a way to maintain the																			
	Assess cost/schedule																			
	Analyze systems																			
	Research prefabrication technologies in the industry																			
	find similar projects that have implemented prefabrication																			
	Contact industry specialists																			
update Proposal	Determine the most effective																			
	areas for prefabrication																			
	Calculate time/cost saved																			
	Create 3D mock-up of prefabricated systems																			
	Organize and format final report																			
	Arrange final presentation																			

Milestone Activity list	
1	All parties have been contacted
2	Analysis 1 complete
3	Analysis 2 complete
4	all analysis completed

	Analysis 1: Redesign of building envelope
	Analysis 2: Green roof addition
	Analysis 3: Prefabrication
	Analysis 4: BIM implementation
	Breadth activity