

# City Hospital Pennsylvania Phase I



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## **Executive Summary**

The purpose of this proposal is to provide an overview of the three topics that will be researched for my final thesis report on the City Hospital, Pennsylvania project. The City Hospital Phase I is an "L" shaped four-story composite building structure below grade which will provide a research facility, an administrative space, a conference space, and a Central Utility Plant (C.U.P.) which houses the main MEP systems. City Hospital is seeking LEED® Silver Certification for New Construction. To achieve a silver LEED® certification the project intends to earn 35 points. My research will include alternative methods to the systems used in Phase I.

The first research topic is an issue that relates to the construction industry as discussed in the PACE Roundtable. This topic will identify the issue of Building Information Modeling- 4D modeling on the City Hospital project. The next two topics; electrical wiring methods and LEED® Gold Certification execution are technical analyses that will also be breadth analyses for my proposal as shown in the weight matrix. The alternative methods chosen will be analyzed using different investigation areas such as constructability review, value engineering analysis, and schedule reduction.

This report contains information about the critical issues facing the construction industry; these issues also face the City Hospital project. Also contained in this report are two breadth analyses which include an analysis that will address the problems on the project, a proposed solution with theoretical benefits, research timetable, and a weight matrix that will illustrate the analyses and core areas of investigation.

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### **I. Critical Issues Research Topic**

#### ***Critical Issue:***

After further thought and discussion at the Roundtable, the topic that I was most interested in and felt would be most applicable for my thesis project is the use of Building Information Modeling (BIM)-4D modeling on the City Hospital project. Although this technology was not implemented on Phase I, there are some advantages to designing the hospital without using 4D modeling. Building Information Modeling is very exciting because it potentially solves a lot of conflict issues by helping the design team to determine possible conflicts in the design of a project before construction begins. This potential is the reason why I decided to research the amount of time and steps it would have taken to start up the 4D modeling process on Phase I of City Hospital project, especially because this project requires a great amount of communication and coordination.

#### ***Goals:***

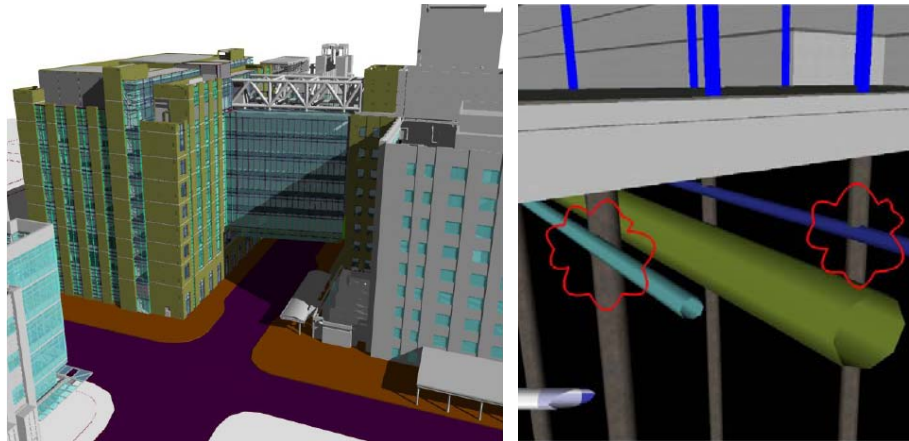
The goal of the proposed research would be to: research the time line needed to start up the 4D model process, investigate how the use of BIM during the design phase would have potentially eliminated most of the conflicts between trades during the construction phase as shown in Figure 4.1 which would reduce the cost and schedule of the project, evaluate how innovative technology such as 4D CAD modeling is an effective tool for evaluating the construction process, research who and how would personnel be trained to use BIM, and also create awareness of the advantages of using BIM.

#### ***Research Methods:***

Weighing and comparing the advantages and disadvantages between using BIM and not using BIM will form the foundation of this research. It will be crucial to speak to the Mike Ellis, MEP coordinator of Phase I; Paul White, MEP coordinator of Phase II (which uses BIM); and Mr. Yan, coordinator of ViCON at Turner Construction. I can also tap the wealth of knowledge possessed by my advisor, Dr. Messner, who is very knowledgeable in this area of study, and the architectural engineering graduate students who are currently researching BIM. A list of questions I would possibly ask Paul White and Mr. Yan can be found in Figure 4.2 and a timetable in Figure 4.3 shows how I plan to execute my research.

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[http://www.virtualbuilders.org/VBR\\_Presentations/ViConTurner.pdf](http://www.virtualbuilders.org/VBR_Presentations/ViConTurner.pdf)

**Figure 4.1: MEP Clash detection**

### Questions:

#### Questions for Paul White:

1. Why BIM (4D modeling) was not used in Phase I?
2. How and who would be trained for the use of 4D modeling if it were to be used on Phase I? What skills are required?
3. What would have been the benefits to using this technology on Phase I? Explain.
4. Were there any conflicts that could have been avoided if this technology was used on Phase I?
5. What are the necessary steps required in implementing 4D modeling?
6. What are some of the challenges being faced in Phase II with the use of this new technology?
7. How much time would have been considered necessary to start up the 4D modeling process? How long did it take in Phase II?

#### Questions for Mr. Yan:

1. How much time would be considered necessary to start up the 4D modeling process on a project?
2. What are the necessary steps required in implementing 4D modeling on a project?
3. What are some of the advantages in using BIM-4D modeling on a project?
4. What parties would be involved in the BIM process?
5. Are owners becoming more responsive to the idea of BIM?
6. How does Turner initiate BIM to their clients?

**Figure 4.2: Research Questions**

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## II. Technical Analysis 1: LEED® Rating

Green buildings and sustainable methods of construction are emerging topics and will only continue to grow. City Hospital is seeking LEED® Silver Certification for New Construction which requires the project to earn between 33- 38 points. Some of the credits the hospital are applying for are construction activity pollution control, complying to minimum energy performance standard as set forth by ASHRAE90.1-2004, storage and collection of recyclables on site, and complying with minimum indoor air quality. The basis of my research is to identify four LEED® points that would explore different design and construction methods to encourage a Gold LEED® rating (39-51 points). For example, the goal of using more efficient fixtures and innovative wastewater technologies, such as using ‘gray water’ for landscaping irrigation can be aligned with *WE Credit 2: Innovative Wastewater Technologies*. The second analysis on this topic would be a more detailed research on the LEED® credit *WE Credit 2: Innovative Wastewater Technologies* from the credits established initially for LEED® Gold rating. This analysis will require a large amount of research that will impact the schedule and the cost. The credits I will pursue will implement value engineering and schedule reduction.

### Methodology

1. Review the LEED® points that are intended to be achieved on the project
2. Literature review to become familiar with the different LEED® points
3. Investigate the implementation of *WE Credit 2: Innovative Wastewater Technologies* which includes research options such as specify high-efficiency fixtures to reduce wastewater volumes and on-site wastewater treatment systems
4. Identify four LEED® additional points for Gold Certification (includes *WE Credit 2*)
5. Assemble the data into a written report for review by advisor

In order to assure that the credits chosen are reasonably achieved on the City Hospital Project, I will review my findings with the LEED® consultant, Gabriella Edwards on this project and faculty advisor, Dr. Riley. I will also discuss my ideas with Elena Enache-Pommer, a graduate student in the architectural engineering department, who is currently researching green building deliveries. The U.S. Green Building Council’s (USBGC) website will provide me with additional resources related to the credits that will help further my research.

### Tools

1. U.S. Green Building Council website ([www.usgbc.org](http://www.usgbc.org))
2. LEED® Green Building Rating System for New Construction & Major Renovations (LEED®-NC) Version 2.2
3. Microsoft Excel

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### **III. Technical Analysis 2: Conduit vs. Busduct**

A question arose during the construction phase of the City Hospital project on whether it would be cheaper and more efficient to use bus ducts in place of the conduits which are currently being installed in the building. Busduct consist of a rigid piece of copper or aluminum, usually in flat bars and conduits are a raceway of circular pipes; both containing conductors which carry current to distribute power throughout the building. An issue on the construction site was the installation of conduit was an extensive process that reduced the productivity of other trades in onsite. The basis of my research is to investigate which wiring method would be economical.

#### **Methodology**

My analysis of the wiring system would begin by first determining the use and power need of the circuit and the environment in which the wiring must operate. After researching the cost information the comparison of the two methods will be expected to differ in cost, have an impact on the schedule due to installation, and the space required on the site for installation. Finally, I would conduct a labor savings analysis on both wiring methods.

To obtain information about the disadvantages and advantages of using either system, I would contact Keith Busch and Joe Roscha from Truland Systems; and Tom Bedesem, MEP superintendent on Phase I and previously an Electrical subcontractor. Dr. Horman is also very knowledgeable with electrical systems and may be a great reference for my research. After further research and discussions, I will be able to compare both methods and determine which electrical wiring would be cost-effective. Below is a set of steps I will exercise to research this topic:

1. Review literature on conduit and busduct wiring methods
2. Gather architectural and electrical drawings to meet with Keith Busch and Joe Roscha from Truland Systems in Washington, D.C.
3. Calculate a labor savings analysis
4. Compare costs, durations (impact on the schedule), and material amounts between wiring methods
5. Assemble the data into a written report for review by advisor

#### **Tools:**

1. Microsoft Office
2. City Hospital construction documents
3. Greyhound Round trip ticket to Washington, D.C.

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### IV. Timetable

Figure 4.3 illustrates the time frame in which I plan to execute my research.

Date	Analysis	Research Schedule
01/09/08	Critical Issue	Conduct phone interview with Paul White (morning)
01/09/08	Critical Issue	Conduct phone interview with Mr. Yan (afternoon)
01/21/08	Critical Issue	Review literature on BIM 4D-modeling
01/24/08	Critical Issue	Contact Grace Yang, pioneer of BIM at PSU, for advice
01/25/08	Critical Issue	Review ideas with graduate students for feedback
02/03/08	Critical Issue	Summarize and document results of study
02/06/08	Critical Issue	Review research with advisor, Dr. Messner
02/13/08	Critical Issue	Revisions
12/10/07	Analysis 1	Review the LEED® points that are intended to be achieved on the project
12/12/07	Analysis 1	Literature review to become familiar with the different LEED® points
01/17/08	Analysis 1	Review points anticipated with Gabriella Edwards, Turner
01/18/08	Analysis 1	Investigate the implementation of <i>WE Credit 2: Innovative Wastewater Technologies</i>
02/01/08	Analysis 1	Identify four LEED® additional points for Gold Certification apart from <i>WE Credit 2: Innovative Wastewater Technologies</i>
02/25/08	Analysis 1	Assemble the data into a written report for review by advisor
03/05/08	Analysis 1	Revisions
01/08/08	Analysis 2	Review literature on conduit and busduct wiring methods
01/11/08	Analysis 2	Gather Architectural and Electrical drawings to meet with Keith Busch and Joe Roscha from Truland Systems
01/11/08	Analysis 2	Calculate a labor savings analysis
01/18/08	Analysis 2	Compare costs, durations (impact on the schedule), and material amounts between wiring methods
02/01/08	Analysis 2	Review ideas with graduate students for feedback
02/06/08	Analysis 2	Assemble the data into a written report for review by advisor
02/13/08	Analysis 2	Revisions
03/31/08	Presentation	Produce Summary Book & Presentations
04/10/08	Presentation	Revisions and practice
04/14/08	Presentation	Faculty Jury

Figure 4.3 Timetable



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### V. Weight Matrix

The weight matrix below illustrates the different analyses, as presented in the Critical Issues Research and Technical Analysis section of this report that will be areas of investigation addressed in the City Hospital thesis proposal. The proposed topics will be analyzed in areas such as constructability review, value engineering analysis, and schedule reduction.

The research for 4D modeling on City Hospital will mostly consist of literature review and phone interviews. The implementation of 4D modeling, if it was used on Phase I may have reduced time on the schedule. The uniqueness of the clash detecting system used in BIM could have minimized conflicts that may take place during the construction phase. This in turn would have reduced the cost of construction due to ease of coordination and integration with trades and MEP systems.

To implement a higher LEED® rating for the hospital, this will require familiarity of the different LEED credits and its points. The proposed points will add value to the building and evaluate the project in terms of constructability. For example, if innovative wastewater technologies such as water fixtures are reviewed for efficiency this may save the owner initial and life cycle cost and ease mechanical coordination.

The analysis of an alternative wiring system will require knowledge of different wiring systems. Reviewing the wiring methods in terms of constructability will reduce coordination issues. For example, if busducts are installed instead of conduit in the hospital, this may allow for the availability of space for other system installations as well as increase productivity for other trades. This will accelerate the project schedule and decrease cost in equipment and labor.

Weight Matrix					
Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
<b>Critical Issue Topic: BIM</b>	15%	5%	5%	10%	35%
<b>Analysis 1: LEED® Rating</b>	10%	15%	10%	-	35%
<b>Analysis 2: Electrical Wiring</b>	5%	10%	10%	5%	30%
<b>TOTAL</b>	30%	30%	25%	15%	100%

Figure 4.4 Weight Matrix Diagram

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# Appendix 1: Breadth Studies

## ***Breadth Study #1: Sustainability***

This technical analysis will consist of identifying four LEED® points that would explore different design and construction methods to encourage a Gold LEED® rating on the City Hospital project. The hospital is currently intending to be LEED® Silver certified. From the credits established initially for LEED® Gold rating, a detailed analysis would be conducted on *WE Credit 2: Innovative Wastewater Technologies*. Research options include high-efficiency fixtures to reduce wastewater volumes and on-site wastewater treatment systems.

## ***Breadth Study #2: Electrical***

This technical analysis will consist of investigating an alternative electrical wiring method in the City Hospital. The hospital is currently using conduit wiring. An issue on the construction site was the installation of conduit was an extensive process that reduced the productivity of other trades onsite. The basis of my research is to investigate which wiring method would be economical on the City Hospital project.