

AE 481W

[Updated: 02/17/2010]

Matthew Dabrowski
Construction Management
Consultant: Dr. Chris Magent



Courtesy of SCA

[Rydal Park Medical Center Addition]
[Rydal, Pennsylvania]

[PROPOSAL: IMPROVING EFFICIENCY WITHIN THE AEC INDUSTRY]

[The following proposal presents a research overview regarding the Rydal Park Medical Center Addition. Three analyses will be conducted during the spring 2010 semester that will examine efficiency within this Medical Center through the project team, mechanical system and performance of the building envelope. The final portion of the report presents a tentative schedule with research milestones.]



RYDAL PARK MEDICAL CENTER ADDITION

PROJECT INFORMATION:

FUNCTION : INSTITUTIONAL CARE
BUILDING COST : \$26,590,000
SIZE : 142,862 SQUARE FEET
DATES OF CONSTRUCTION :
SEPT 09' - MARCH 11'
DELIVERY METHOD : CM @ RISK, DESIGN-
BID-BUILD W/ NEGOCIATED GMP

PROJECT TEAM:

OWNER : PRESBY'S INSPIRED LIFE
DEVELOPERS : GREENBRIER DEVELOPERS, INC.
ARCHITECT : STEWART-CONNERS PLLC
CONSTRUCTION MANAGER :
THE WHITING-TURNER CONTRACTING CO.
STRUCTURAL ENGINEER : WK DICKSON & CO.
MEP ENGINEER : MOORE ENGINEERING

ARCHITECTURE:

- AESTHETICS INTENDED TO INVOKE SENSE OF RESIDENTIAL COMMUNITY LIVING AT A LOCATION WHERE SENIORS MAY RECEIVE SKILLED ELDERLY NURSING CARE.
- 5 STORY STRUCTURE WILL INCLUDE:
 - TWO FLOORS OF PARKING GARAGE SPACE
 - TWO FLOORS OF SKILLED NURSING CARE
 - ONE FLOOR OF CRITICAL MEMORY SUPPORT
- FAÇADE WILL IMPLEMENT A STONE VENEER SYSTEM AND SPRAY APPLIED STUCCO AS WELL AS CURTAIN WINDOW WALL & PELLA WINDOWS TO MATCH THE EXISTING MEDICAL FACILITY

STRUCTURAL:

- FOUNDATION :
- HELICAL GEO-PIER STONE COLUMN FOUNDATION SYSTEM WILL PROVIDE SUPPORT UNDER SPREAD FOOTERS
- SUPERSTRUCTURE :
- POST-TENSION TWO-WAY CONCRETE SYSTEM
 - REINFORCED CONCRETE COLUMNS
 - REINFORCED MASONRY MASS SHEAR WALLS (GRAVITY SYSTEM), LOCATED MAINLY AT STAIRTOWERS, UTILIZED AS THE LATERAL SYSTEM
- ROOF STURCUTRE :
- NON-COMPOSITE ROOF DECK MAINLY SUPPORTED BY K-SERIES JOISTS AND SEVERL INTERMEDIATE WIDE FLANGE BEAMS BETWEEN COLUMNS

MEP SYSTEMS:

- FOUR PIPE AIR/WATER HVAC SYSTEM:
 - THREE FAN COIL UNITS (400 - 1200 CFM)
 - EIGHT AHU'S (630 - 3770 CFM)
 - FOUR ENERGY RECOVERY UNITS (FIRST FLOOR)
- BUILDING POWER SUPPLIED BY PECO:
 - 15 KW SWITCHGEAR TO STEPDOWN POWER
 - 208/120V 3 PHASE 4 WIRE WIRE SYSTEM
 - 350 KW EMERGENCY GENERATOR (FIRST FLOOR)
- COMBINATION DRY AND WET PIPE FIRE SUPRESSION SYSTEM

CONCEPTUAL SKETCH



MATTHEW JAMES DABROWSKI
ARCHITECTURAL ENGINEERING | CONSTRUCTION MANAGEMENT
<http://www.engr.psu.edu/ae/thesis/portfolios/2010/mjd5060>

Table of Contents

Thesis Abstract..... 2

Table of Contents..... 3

Executive Summary..... 4

Project Overview..... 5

Analysis #1: Enhanced Project Collaboration Techniques 6

 Problem – Critical Industry Issue 6

 Goal 6

 Methodology..... 6

 Available Resources and Tools..... 6

 Expected Outcome..... 6

Analysis #2: Energy Consumption and Construction Efficiency..... 7

 Problem – Mechanical Breadth Study..... 7

 Goal 7

 Methodology..... 7

 Available Resources and Tools..... 7

 Expected Outcome..... 7

 Analysis 2 UPDATE (2/17/10): Energy Consumption / Wall Section Improvement..... 8

Analysis #3 (SEE UPDATED): Building Envelope Performance Review..... 9

Analysis #3 (UPDATED 2/17/10): Photovoltaic Array Powering Parking Garage Lighting 10

 Problem – MAE Requirement (AE 597D) and Structural Breadth Study..... 10

 Goal 10

 Priorities to Catch up with Work..... 10

Weight Matrix..... 11

Proposed Spring 2010 Research Schedule..... 11

Appendix A: Breadth Studies and MAE Requirements 14

Executive Summary

The following proposal outlines three analyses that will be performed regarding Rydal Park's Medical Center Addition. The focused theme for this research revolves around improving efficiency both within the project team and the building design. This research will cover many sides of the design and construction process including project delivery, energy usage, sustainable performance, and envelope efficiency. During the spring 2010 semester this research will be performed, analyzed, critiqued and compiled for presentation to the Penn State Architectural Engineering Faculty.

Analysis #1: Enhanced collaboration Techniques and improved goal alignment within project teams

The idea to research this topic developed through the personal observation of the disconnected project team during the 2009 summer. Analyzing this project team and comparing it to that of a collaborative project team will pinpoint elements of success. Whiting-Turner is contracted as the construction manager at risk with a negotiated GMP. This method will be compared to an alternate method such as integrated project delivery (IPD). The final result of this research will be an execution guide that will assist project teams in the future.

Analysis #2: Energy Consumption and MEP Coordination

Many times mechanical systems are chosen on the basis of low upfront costs. An energy model of this building will be developed in order to assist with the selection of an alternate mechanical system. The alternate mechanical system will be selected on the basis of reducing the life cycle energy cost of this building. At the same time a short interval production schedule will be created for the many trades involved with MEP coordination.

Analysis #3: Building Enclosure Performance

During the project manager interview for technical assignment three, it was proposed to analyze the flashing details in order to uncover potential water-tight issues. This topic will be taken further and the entire building envelope will be reviewed. This review will cover thermal efficiency, constructability and a detailed cost analysis regarding the building enclosure. There is potential for this analysis to wrap up with the development of a physical mock-up of the envelope if the required samples are acquired. More information will be collected during the 2009-2010 winter break (I will be interning with WT on this project during break).

Project Overview

Presby's Inspired Life develops and manages continuing care communities that provide an opportunity for senior citizens to live their lives within a relaxing residential surrounding while retaining peace of mind that if any health emergency were to arise, assistance would be immediately available. This location, Rydal Park, is a continuing care retirement community where seniors begin living at homes that are cozy cottages and as their conditions progress (if any exist), they will eventually move into the medical facility at the center of the campus. This medical addition has finishes that closely resemble would be found within a luxury hotel, but with the added necessity of being equipped for medical emergencies.

Stewart-Conners Architects was contracted for the design of this medical addition in February 2008. From 2008 until financial closing in October 2009 the project was placed on hold twice hindering the commencement of the project. Project team inefficiencies were personally observed which will be addressed within the research to be conducted in the following semester.

The Whiting-Turner Contracting Company is the construction manager at risk who will oversee construction of this medical center addition. The project team mobilized on November 16th 2009 and will begin substructure construction in mid-December. The building will be built during an 18 month period and cost approximately \$26,590,000. Given the financial constraints of Presby's Inspired Life, LEED was not incorporated into this building. Several green elements such as a rooftop garden and generous amounts glazing for improved day lighting are included in the building's design.

Currently Whiting-Turner is dealing with the difficulties of underground utility relocation and the winter season. As the utilities wrap up, the GeoPier foundation will begin which will also take additional time given the weather conditions. The concrete structure is planned to begin towards the end of February.

Analysis #1: Enhanced Project Collaboration Techniques

Problem – Critical Industry Issue

During the fall 2009 PACE Conference, the Business Networking: Expanding Circles and Creating Opportunities breakout session discussed the entry and implementation of Integrated Project Delivery (IPD). The time of professionals within the AEC industry is extremely valuable and should be utilized with careful thought and planning. Within today's industry there exist many inefficiencies within the development and design of buildings. These inefficiencies need to be pinpointed, addressed, explored and corrective means need to be implemented. Each consulting firm within the design and construction process must understand their specific roles and when they overstep their intended professional boundaries. Given the disconnected relationship between each professional group for this medical addition, the impact of enhanced collaboration techniques and improved goal alignment will tackle this critical issue.

Goal

The final building design and commencement of construction for the Medical Center Addition has been placed on hold twice between February 2008 and November 2009. The intent of this research will be to pinpoint the inefficiencies within this project and how it came to standstill during this period. An Integrated Project Delivery Execution Guide and/or Enhanced Collaboration & Goal Alignment Guide will be developed using this project team as a lessons learned case study.

Methodology

- Examine all available documents regarding the design process throughout 2008 and early 2009
- Develop an extensive timeline of events which documents the entire preconstruction life of this project
- In-depth exploration of the delivery method which the project is currently utilizing
- Research Integrated Project Delivery or other projects which have implemented enhanced project collaboration techniques (Seven Group – Cambria Office Building / AIA IPD Documents)
- Pinpoint elements of these projects which have fostered success and develop methods in which to implement them properly on this project and future projects
- Interview as many members within the entire project team in order to gather critical feedback

Available Resources and Tools

- Owner Representative and Industry Professionals
- Project Documents during the Feb 2008 – Nov 2009 Period
- IPD & Enhance Project Collaboration Case Studies (AE 597D: Cambria Office Building)
- Penn State Research – BIM Execution Guide, AE 572: Project Development and Delivery Methods

Expected Outcome

All of the researched gathered from the above methods will be compiled into an execution guide that will help owners as well as all other members of the design and construction process navigate through the development and final delivery of a building. The AEC industry of today is completely different than it was half a century ago, but is still utilizing similar habits. The manner in which professionals are contracted must be addressed, and updated for today's world, but must also allow for changes in the future.

Analysis #2: Energy Consumption and Construction Efficiency

Problem – Mechanical Breadth Study

Since this medical addition is a part of a large campus and is a building that the owner will be occupying for an indefinite period of time, it is important to implement systems that are efficient over the lifetime of the building. Mechanical systems should not be simply selected due to low upfront costs, but should be properly researched so that they last and return the best savings over the 50 plus years of the building's existence. This research will examine inefficiencies within the selected four pipe air/water HVAC system. Once an alternate HVAC system is selected, any components that have been centrally located on the roof (or possibly floor level) will be explored with a structural analysis.

Goal

This research will explore alternate mechanical systems and the structural impacts on the building frame of these systems. The alternate mechanical system will be selected at an efficiency basis, therefore a LEED study, life cycle investigation, and cost analysis will be performed. Along with this research a short interval production schedule will be created for the construction of the typical 115 resident rooms of this facility.

Methodology

- Develop on Energy 10 model of the Medical Center and research alternate mechanical systems that fit the buildings criteria
- Determine the proper structural analysis that is required for the alternate mechanical
- Perform a cost analysis and energy consumption study with the alternate system
- ~~Develop a SIP schedule for the typical resident rooms;~~
- Compile a LEED Analysis and Life Cycle Cost, **Will go hand in hand with Analysis #3**

Available Resources and Tools

- Computer Software: Energy 10, Basic 3D Modeling, ~~Navisworks (4D SIP Schedule Visualization)~~
- Industry Professionals, Architectural Engineering Faculty (Primarily Mechanical and Structural)
- The Whiting-Turner Project Team
- Literature/Books/Course Notes from AE 308/AE 310/AE 404

Expected Outcome

Through this analysis, it is expected to discover an HVAC system that will provide a better life cycle solution to the cooling, heating and air handing demands of this facility. Through research of alternate mechanical systems it will become clear as to the extent of the structural redesign necessary to house the designated system. The main criteria for this selection is to increase building efficiency, which means the upfront cost may increase but may improve the overall life cycle expenditures. The life cycle cost analysis should demonstrate that the purchase of an efficient system, possibly with a higher upfront cost, will ultimately result in lower bills and maintenance fees during a 50 year period. It is also expected that with the development of a sip schedule, that schedule acceleration can easily occur as the resident rooms are built.

UPDATE**Analysis 2 UPDATE (2/17/10): Energy Consumption / Wall Section Improvement**

Due to research results and discussions with Dr. Magent and Dr. Parfit, this analysis will only examine alternate mechanical systems. After performing an alternative mechanical system study with Energy 10, it was discovered that the most economical HVAC option for energy cost over time is a PTAC (Packaged Terminal Air Conditioner) unit. This unit does not require large air handling units or cooling towers as was envisioned during the development of this proposal in December 2009. Therefore large equipment is not required on the roof, which eliminates the structural breadth within this proposal. For that reason the structural breadth will be located with analysis #3 which will analyze photovoltaics.

Analysis #3 was originally a building envelope performance study which began with examining wall sections and architectural details. The current façade type is a stucco EFIS system which has resulted with a very limited amount of research, providing very little information for which to study.

Analysis #3 (SEE UPDATED): Building Envelope Performance Review

Problem

During the project manager interview for technical assignment three, potential research topics were discussed. One topic that was well received was performing an in-depth review of the flashing details. The project manager felt that the current details provided by the architect are incomplete and still require extensive review. This analysis will include examining the flashing details, but will go beyond this issue and examine the thermal efficiency, opportunities for cost reduction, and constructability of the current building façade system.

Goal

Through this flashing detail review, all detailed sections that may potentially create water-tight or thermal issues will be uncovered and properly addressed prior to encountering them in the field. Other building envelope systems that can provide improved thermal efficiency will be examined. Methods to utilize these alternative envelope systems will be developed along with a cost analysis and constructability investigation. This study should prevent the need for additional rework after the first big rainstorm following the building completion.

Methodology

- Questions to be addressed (More to be developed):
 - How is the system intended to perform and how should it be installed?
 - What trades are critically affected by the envelope?
 - How will the system keep water out or drain water?
- Compare basic/standard details from other projects to the ones for this building
- Pinpoint elements of the building envelope that are of concern and properly address corrective actions to improve the enclosure
- Analyze the thermal efficiency and explore other systems through cost analysis and constructability
- Potential to develop a physical mock up of several details and test their water tight effectiveness

Available Resources and Tools

- The Whiting-Turner Project Team (Research will involve developing questions for interviews)
- Industry Professionals, Architectural Engineering Faculty
- Relevant construction details
- Physical samples or mock ups of the enclosure system or elements of the enclosure system
- AE 542: Building Enclosure Design

Expected Outcome

The results from this analysis will be relayed to Whiting-Turner which will allow the project team to properly address issues discovered within the building enclosure. Since the project has just begun the site/civil phase, there is still a significant amount of time to uncover incomplete elements within the construction details and correct them as required. It is not expected to find every single issue but rather the larger concerns that the team may have overlooked during the hectic bid period. If an alternate enclosure system is discovered and provides a significant of additional benefits, it may also become implemented within the building.

UPDATE**Analysis #3 (UPDATED 2/17/10): Photovoltaic Array Powering Parking Garage Lighting****Problem – MAE Requirement (AE 597D) and Structural Breadth Study**

This analysis will build upon the topic of energy efficiency within buildings by utilizing a photovoltaic array to power two levels of parking garage space. The current building design does not have equipment currently located on the roof and is not located near any tall buildings or trees. This provides a perfect surface to utilize a PV array which will help cut energy costs of lighting the parking garage. This analysis will cover material discussed in AE 597D (Sustainable Building Design) through the design and implementation of the PV array. Along with this, the roof members will be properly redesigned in order to support these loads.

Goal

The results of this analysis will indicate a recommendation of whether or not to pursue a PV array. It is optimistic that results will indicate that over a 50 year life span of the building that this type of system will easily pay for itself. The final research product should contain a basic 3D model, solar energy collected, additional joist member sizing required and a life cycle analysis indicating that the system should be pursued.

Priorities to Catch up with Work

- Select a manufacturer / brand of solar panel to implement
- Select the photovoltaic array system to be utilized
- Develop a Sketchup 3D model to aid with solar calculations
- Calculate amount of energy that can be obtained for lighting use
- Analyze the roof system ensuring that the roof can support a PV array
- Size the structure beams / joists appropriately
- Analyze the life cycle cost of implementing this system

Weight Matrix

Analysis Description	Research	Value Engr.	Constr. Review	Sched. Reduc.	Total
Analysis #1: Enhanced Project Team Collaboration	25%	0%	0%	10%	35%
Analysis #2 Alternate Mechanical System	10%	10%	10%	10%	40%
Analysis #3: Building Envelope Performance	5%	10%	10%	0%	25%
Total	40%	20%	20%	20%	100%

Proposed Spring 2010 Research Schedule

Tasks:

Analysis #1 (Tasks 1-5)

1. Review project documents from 2008-2009, develop preconstruction timeline
2. Examine delivery style implemented on this project
3. Research alternate enhanced project collaboration delivery styles
4. Pinpoint critical elements and develop a guide
5. Interview project members, gather critical feedback and update final guide

Analysis #2 (Tasks 6-10)

6. Develop an Energy 10 model
7. Research and select appropriate alternate mechanical system
8. Perform structural calculations for new system
9. Develop a cost analysis and SIP schedule for the resident rooms
10. Compile a LEED analysis and life cycle cost breakdown

Analysis #3 (Tasks 11-15)

11. Research Photovoltaics / Select Manufacturer
12. Develop PV Array Data (Potential Energy Available to Collect)
13. Create a 3D Model to assist with diagramming solar movement and calculations
14. Analyze the roof and properly re-size structural members as needed
15. Finalize analysis #3 with a life cycle cost and recommendations to pursue

The following page outlines when the previously listed activities will take place during the spring 2010 semester. Please visit the proposal section (on my thesis webpage) for an enlarged single page .pdf version of the schedule found on the following page.

Matthew Dabrowski
Consultant: Dr. Magent

Last Update: 02/15/2010
Current Version: 02/22/2010
*Analysis #3 Revised After 02/16 Go-No Go Meeting

Penn State University - Senior Thesis Spring 2010 Schedule - Rydal Park Medical Center Addition

Week:	01/11/10	01/18/10	01/25/10	02/01/10	02/08/10	02/15/10	02/22/10	03/01/10	03/08/10	03/15/10	03/22/10	03/29/10	04/05/10	04/12/10	04/19/10	04/25/10	
Task #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	Review 08-09 Project Docs																
2	Examine Utilized Delivery Style																
3	Research Alt. Enhanced Proj. Collaboration (A/A)																
4																	
5																	
6	Learn and Develop Energy 10 Model																
7	Mech. Breadth - Alt. Systems Resrch.																
8	Analyze Building with New HVAC Sys.																
9																	
10																	
11	Research Photovoltaics																
12	Develop PV Array / Potential Energy Collected																
13	Develop 3D Model For Solar Study																
14	Struct. Breadth - Roof																
15	Life Cycle																
	Update Milestone Schedule / Upload to eStudio Page - Every Monday																

Current Date - 02/08

Milestone Activity List

1. Have necessary questions developed and sent out. Familiarized with Energy 10 software and begin analyzing data collected from the Energy 10 Model.
2. Researched / selected an alternate mechanical system and inputted into the Energy 10 Model. Achieved a good level of understanding with the early phases of this project.
3. Selected to PV Array system, have solar location data and calcs performed. Begin the structural calcs for the PV Panel loads on the roof.
4. All research and data collection completed. Halfway through compiling and writing the report describing what has been found. Begin the powerpoint presentation.

- Analysis 1: Tasks 1-5
Analysis 2: Tasks 6-10
Analysis 3: Tasks 11-15
- Analysis includes primary CMI studies
Analysis includes Mechanical breadth studies
Analysis includes MAE / Structural Breadth requirements

Appendix A: Breadth Studies and MAE Requirements

Mechanical Breadth:

With the use of Energy 10, a model of the energy demands of the building will be created. This model will assist with the selection of an alternate mechanical system. Knowledge of mechanical design will be displayed through hand calculations and checks to the Energy 10 model. This study will also tie into the study of the building envelope. If an improved enclosure system is selected, the demand on the mechanical system will be minimized allowing for sizing and redundancy reductions.

Structural Breadth:

The current roof has not been designed to house any PV panels or equipment. A PV array will be designed that will power the lighting of the parking garage on the first two floors of this facility. An analysis of the roof's structural system must be conducted to ensure that the PV panels and accompanying support system can be supported. This analysis may require several structural members to be redesigned in order to carry the alternate equipment.

Incorporation of 500-Level Architectural Engineering Courses

Knowledge gained from the graduate courses listed below will be utilized to study the delivery system, analyze the energy efficiency and sustainability, and explore the building envelope. These courses have laid the groundwork to aid in selecting a more efficient delivery method, develop an execution guide for enhanced project collaboration, improve the level of sustainable design and to locate elements within the envelop requiring improved detailing.

- AE 572: Project Development and Delivery Planning
- AE 597D: Sustainable Building Methods
- AE 542: Building Enclosure Design