GEISINGER GRAY'S WOODS AMBULATORY CARE CAMPUS PHASE 1

PATTON TOWNSHIP, CENTRE COUNTY, PENNSYLVANIA

FINAL PROPOSAL
SENIOR THESIS
December 18th, 2007

ERICA CRAIG
CONSTRUCTION MANAGEMENT
DR. RILEY

FINAL THESIS PROPOSAL

Table of Contents

EXECUTIVE SUMMARY

SECTION I

This thesis proposal is intended to provide defined areas of investigation to be completed in the Spring Semester from not only the Geisinger Gray's Woods project but also from issues facing the construction industry today. Investigations will include alternative methods, value engineering, and schedule compression. After a general project overview, the three analyses will be identified: Concrete Slabs, HVAC System, and Approvals & Permitting. Following, an illustration of how time and effort for next semester for each analysis is demonstrated concluded by a summary of each breadth study.

Construction of the 64,350 SF Gray's Woods medical office building began on April 23rd, 2007 and the Owner anticipates moving in on July 22nd, 2008. Currently on schedule, the building consists of cast-in-place concrete pier footings and structural steel columns and beams. HVAC equipment includes a chiller, boiler, and rooftop units. Brick masonry, EIFS and a curtain wall system create the exterior facade of the building. Each floor is comprised of waiting areas, and check-in kiosks as well as exam rooms, nursing stations, a pharmacy, laboratories, and procedure rooms. The building is attempting LEED certification. With EwingCole as the project Architect/Engineer and Alexander Building Construction as the project's Construction Manager, Geisinger hold paramount quality, value, partnerships, and advocacy.

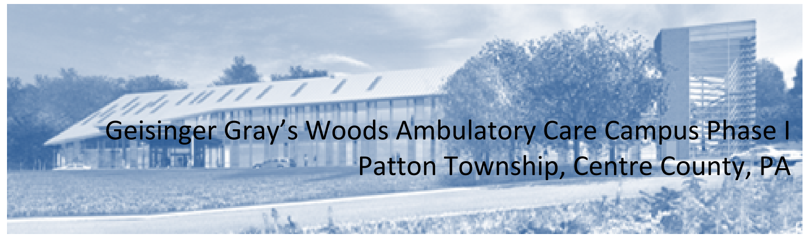
<u>Breadth Study - Structural</u>

Second floor and roof slabs are designed using lightweight concrete on composite metal decking. Although both lightweight and normal-weight concrete can fulfill the same structural function, there is a significant cost premium for lightweight concrete. The first thesis analysis will show a comparison of the concrete slabs, a redesign of the structural steel system as well as an additional cost comparison. By altering the lightweight structural concrete slabs to normal weight concrete, the project costs will be reduced. This requires a structures breadth study.

<u>Breadth Study – Mechanical & Architectural</u>

As stated previously, the HVAC system is comprised of a 400-ton cooling tower, 250-ton electric chiller, three modular rooftop air handling units, and a hot water boiler. The large boilers and chillers required resulted in a separate building on the North-West corner of the main building. The boiler/chiller building is behind the main building so the visual of the green roof is only seen by those visiting Gray's Woods and parking in the rear of the building. Having a separate building results in extra exterior facade materials as well were additional piping and ductwork to the building. The second thesis analysis will reduce project costs and alter the interior floor plans to accommodate the HVAC equipment. Furthermore, the green roof will be visible the majority of those simply passing by Gray's Woods Ambulatory Care Campus. The HVAC system analysis will require mechanical and architectural breadth studies.

The last thesis analysis will focus on the scheduling and project cost effects of the approval and permitting process involved with commercial construction projects. Owners, contractors, design professionals, municipalities, region officials and various government agencies will be surveyed to find ways to alleviated unnecessary costs and time delays due to approvals and permitting.



PROJECT BACKGROUND
SECTION II

Project Schedule

After Geisinger and EwingCole progressed through the design phase of the project, on-site construction began on April 23rd, 2007. Substantial completion of the project is set for June 6th, 2008 and the Owner anticipates moving in on July 22nd, 2008.

Currently, the project is on schedule. Nearly all exterior finishes, including the curtain wall, are finished. Interior studs are complete with drywall started on the second floor. Chillers and boilers are delivered and put in place. Below is a current picture of the Gray's Woods construction.

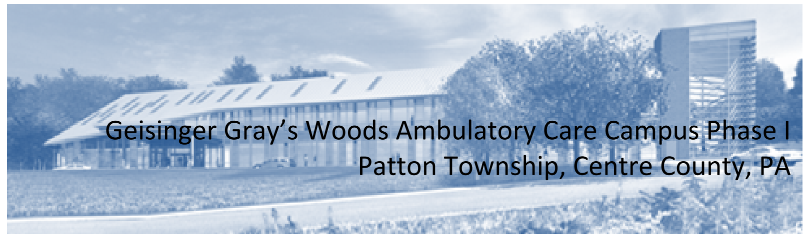
Figure 1: Geisinger Gray's Woods Ambulatory Care Campus, taken 12/14/2007 by Alexander Building Construction, LLC.

Building Systems

<u>Structural Steel</u>

Gray's Woods structural steel frame creates the skeleton for the 2-story 60,000 SF medical office building. Structural steel used is primarily ASTM A992, Grade 50. Bracing for the structural steel frame is provided along four grid lines, two running North-South and two running East-West. While two of the grid lines fall on the exterior of the building, the other two run through interior column lines. HSS steel tubing provides inverted V bracing with gusset plate welded connections to beams and columns. Steel erection was completed using a 150 ton Crawler Crane.

Both the 2nd floor and roof are comprised of composite metal decking. The galvanized composite metal decking is topped with lightweight cast-in-place concrete slabs and reinforced with welded wire fabric.



<u>Cast-in-Place Concrete</u>

Cast-in-Place Concrete is utilized for pier footings, grade beams, slabs and walls. Concrete slabs require a minimum design of 3,000 psi while the foundation and walls require a minimum design of 4,000 psi. The concrete subcontractor used prefabricated steel "Simons" forms for the concrete formwork.

<u>Mechanical</u>

On the North-West corner of the building, a boiler/chiller building will house a boiler, chiller, pumps, and room for future equipment. The design of the building is to support the first 3 phases of the project. Additionally, there are 3 roof top units that include an economizer cycle. Distribution for the VAV (variable air volume) system is through ductwork that includes single duct VAV boxes and hydronic reheat coils. Return air is through the plenum ceiling. For LEED certification, the system is designed for demand control ventilation and heavily commissioned. LEED credits for "Optimize Energy Performance" and "Carbon Dioxide Monitoring" have been included. The system also incorporates a standalone DDC control system with a workstation in the Chiller Room.

Fire suppression for the building was designed into a Combination Wet Sprinkler System and a Wet Dry Deluge Pre-action Sprinkler System. Spray-on fire-proofing is used on all structural steel beams and columns.

<u>Electrical</u>

A 1000A, 480/277V underground service in a concrete reinforced ductbank through Allegheny Power will be provided for Gray's Woods. The 250 kW Emergency Generator will be outdoor packaged. The main emergency Electrical Room on the first floor will house UPS Emergency Power and equipment. To increase LEED credits, the lighting system consists of T8 lamps, compact fluorescents, electronic ballasts and occupancy sensors. Daylight harvesting was also considered in the design.

<u>Masonry/EIFS</u>

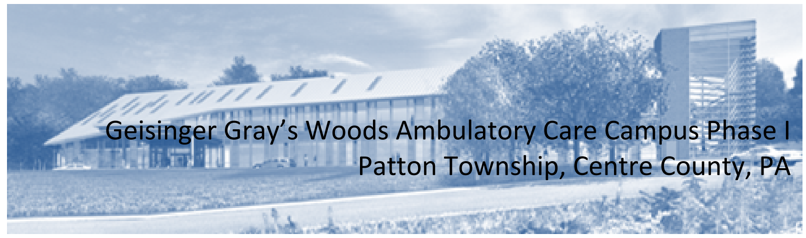
Masonry on the project includes both load bearing CMU and non-load bearing face brick. Face brick connections to metal stud supports include primarily weld on channels and flexible anchor ties. The Exterior Insulation and Finish System (EIFS) is also supported by metal studs. Scaffolding is necessary for both masonry and EIFS installation.

<u>Curtain Wall</u>

The glazed aluminum curtain wall is supported by a metal stud curtain wall. Materials include glazing panels, insulation, structural support, sealants, and finishes. The subcontractor's engineer is responsible for the curtain wall design and PE stamps.

Client Information

"Enhancing quality of life through an integrated health service organization based on a balanced program of patient care, education, research and community service." Geisinger Health System, Mission Statement



As the owner of the project, Geisinger is a physician-led health care system that spans over 40 counties in Central Pennsylvania to serve 2.5 million people. Their vision and values are based on four themes: quality, value, partnerships, and advocacy. With their main focus and drive now on growth, the Gray's Woods Ambulatory Care Campus facility is a step towards expanding the best care to rural areas.

Overall, cost, quality and schedule are all equally important to Geisinger for this project. Set and approved by Geisinger's Health Care Board, the cost of the project cannot exceed the budget due to the fact that the Board will not re-negotiate a new cost. Quality for any health care project is high and is held at the optimum level. Scheduling of the project, more specifically completion, is vital to Geisinger to gain revenue off the project. If owner occupancy is delayed, money will be lost.

Project Costs

The 64,350 SF Gray's Woods medical building has a budgeted building cost of $15 million, $233/SF. Geisinger Health System has set the total project costs, including land and permits, to a budget of $35 million, $543/SF. Bid packages were made for subcontractors by Alexander Building Construction, the Construction Manager. Below is Alexander's schedule of values for the project – dated 9/30/07.

BUILDING SYSTEM COSTS			
Division		SF Cost	Budgeted Cost
1	General Requirements	-	1,212,760
2	Sitework	42.4	2,727,500
3	Concrete	18.7	1,201,464
4	Masonry	4.7	302,000
5	Metals	20.2	1,297,243
6	Wood & Plastics	10.5	673,640
7	Thermal & Moisture Protection	12.3	793,594
8	Doors & Windows	15.4	992,673
9	Finishes	30.9	1,986,755
10	Specialties		-
11	Equipment		-
12	Furnishings		-
13	Special Construction	1.7	109,454
14	Conveying Systems		-
15	Mechanical	61.7	3,973,512
16	Electrical	37.5	2,414,054
	BUILDING COST	$218/SF	$14,108,649
	Additional Building Costs	15.5	1,000,000
	TOTAL BUILDING COSTS	$233/SF	$15,108,649

An additional building cost amount of $1 million was added to adjust for general liability insurance, contingency, construction management fee and elevator costs. The entire project costs ($35 M) include land, permits, FF & E and other soft project costs.

Project Delivery

The Gray's Woods project is being delivered with a construction manager. This approach was chosen because Geisinger Health System values relations and communication. In addition, using a construction manager allows for constructability and design to collaborate early in the design process. For this delivery type on this specific project, the Construction Manager will hire subcontractors to perform the work, hold Owner's and Subcontractor's meetings to manage the cost and schedule of the project and to keep communication flowing between all parties involved, and is not liable for any risk with the project.

Figure 2 below demonstrates the key project parties and the types of contracts held between these parties. Geisinger Health System, the Owner, holds three contracts with:

- Architect/Engineer, EwingCole
- Construction Manager, Alexander Building Construction, LLC
- Civil Engineer, Sweetland Engineering & Associates, Inc.

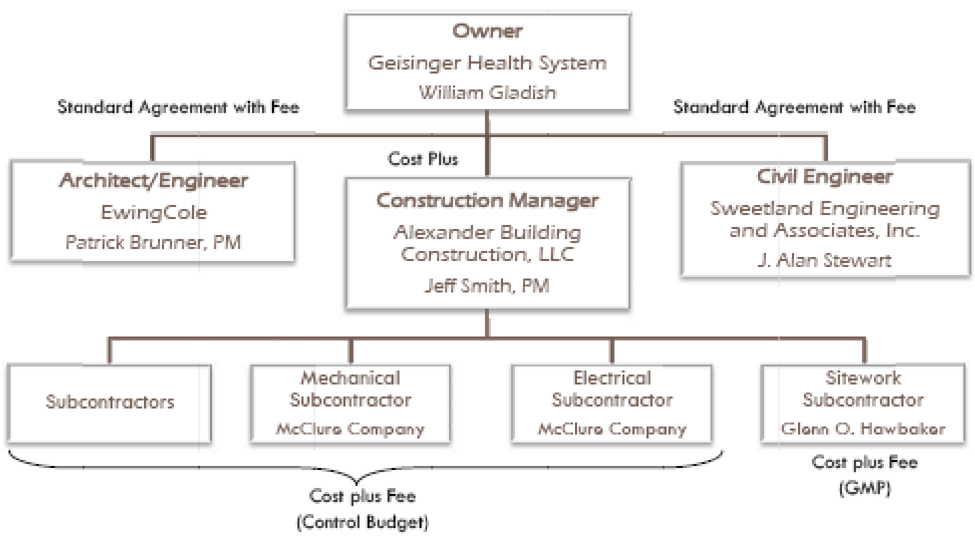


Figure 2: Geisinger Gray's Woods Project Organizational Chart.

ANALYSIS 1: CONCRETE SLABS

SECTION III

<u>Normal Weight Concrete Slabs</u>

Problem Statement:

Although both lightweight and normal-weight concrete can fulfill the same structural function, there is a significant cost premium for lightweight concrete. With the comparison of the concrete slabs, the structural steel design will need to be re-evaluated for the normal weight concrete and well as an additional cost comparison. With over 60,000 SF of lightweight concrete being used for the slabs, a lower material costs could have substantial impacts on the project.

Goal:

While provide information comparing the benefits and drawbacks of the two slab systems, the objective is to lower the total building costs through value engineering the concrete slabs.

	Unit Weight (lbs/ft^3)	Strength (psi)	Material Costs ($/SF)
Normal Weight Concrete	145 – 150	3,000 – 5,000	1.85
Lightweight Concrete	90 – 115	2,500	2.20

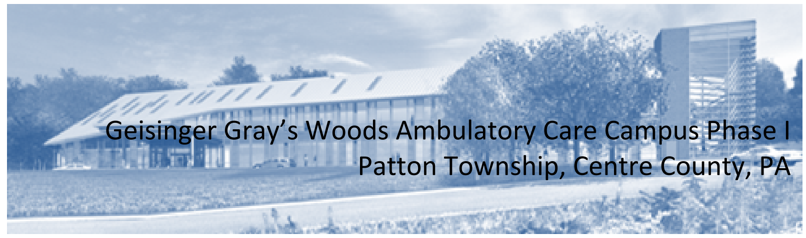
Figure 3: Lightweight and normal weight concrete comparison. Costs from RSMeans 2007. (2 ½ " thick floor slab including finish, no reinforcing.)

Breadth Study:

This analysis will entail a structural breadth study for redesigning the majority of the buildings structural system. If sizes of structural steel members are drastically reduced, the interior floor plan of the building may be affected. Over-head HVAC ductwork and piping may need to be adjusted as well.

Methodology:

- Research Mix Design
- Evaluate the pros and cons of both lightweight concrete and normal weight
- Redesign of structural system
- Value engineering analysis of normal weight concrete slab
- Constructability review of each slab system
- Cost analysis of new structural steel system
- Evaluate any schedule effects of both slab systems
- Fire-proofing effects of new system

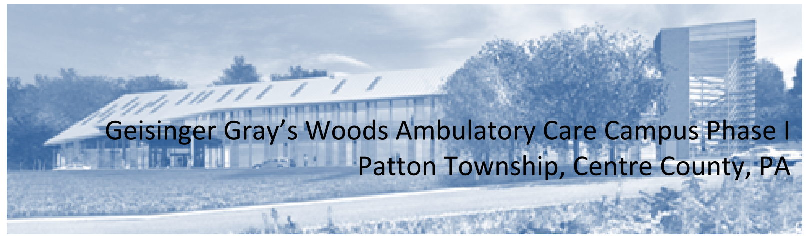


Tools:

- Structural Engineer – EwingCole
- Concrete Subcontractors – Centre Concrete Company
- AutoCAD
- Professor Andres Lepage
- Microsoft Excel
- RSMeans 2007

Expected Outcome:

By altering the lightweight structural concrete slabs to normal weight concrete, the project costs will be reduced. However, the entire structural steel system will need to be redesigned resulting in higher structural steel project costs.



ANALYSIS 2: HVAC SYSTEM
SECTION IV

<u>HVAC System</u>

Problem Statement:

In comparison to typical commercial HVAC systems, using a separate boiler/chiller building requires additional costs and time. Moreover, the large boilers and chillers required resulted in a separate building on the North-West corner of the main building. The boiler/chiller building is behind the main building so the visual of the green roof is only seen by those visiting Gray's Woods and parking in the rear of the building. Having a separate building results in extra exterior facade materials as well were additional piping and ductwork to the building.

Figure 4: View of Geisinger Gray's Woods Ambulatory Care Campus from Gray's Woods Boulevard.

Additionally, with the green roof only on the separate boiler/chiller room, the true benefits of a green roof are not captured. Green roofs can potentially control storm water run off, improve water quality, mitigate urban heat-island effects, prolong the service life of roofing materials and most importantly conserve energy. As mostly a warm season phenomenon, green roofs can reduce heat flow thus reducing energy expenditures on air conditioning.

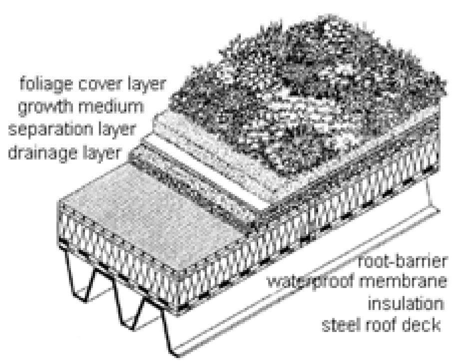
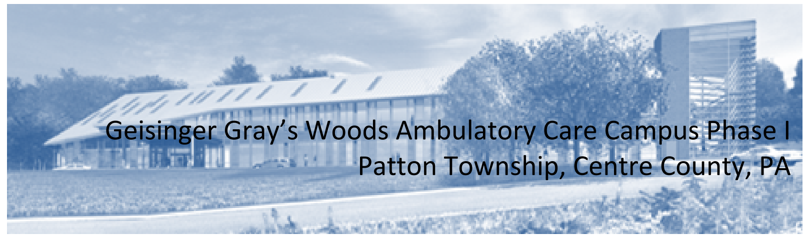


Figure 5: Generic Extensive Green Roof Courtesy of Optigrün Intl. AG.
http://www.wbdg.org/design/greenroofs.php



Goal:

Provide information on benefits and drawbacks of relocating the boiler/chiller room to within, or adjacent to the building as well as and to evaluate the schedule and project costs effects of relocating the HVAC equipment. Also, explore green roof engineering and provide it's benefits to Gray's Woods building by redesign.

Breadth Study:

During the HVAC system analysis, both a mechanical and architectural breadth study will be done. Proposed solutions may also affect the structural system.

Methodology:

- Constructability review of redesign of boiler/chiller room
- Value engineering of redesign of boiler/chiller room
- Interior Architectural floor plan revisions
- Evaluate any schedule effects of relocating the HVAC equipment
- Analyze maintenance effects
- Effects on structural system
- Green roof redesign

Tools:

- Architect and HVAC Engineer – EwingCole
- HVAC Subcontractors – McClure Company
- AutoCAD
- Professor Michael Horman
- Professor Robert Holland
- Microsoft Project
- RSMeans 2007

Expected Outcome:

By relocating the boilers/chiller equipment adjacent to or inside the building the construction schedule will be reduced, the project costs should be reduced, and the interior floor plans will be altered to accommodate the equipment. Furthermore, the green roof will be visible the majority of those simply passing by Gray's Woods Ambulatory Care Campus and the building will reap some of the benefits of green roofs.

ANALYSIS 3: APPROVALS & PERMITS

SECTION V

<u>Critical Industry Issue – Approvals & Permits</u>

Problem Statement:

With scheduling continually being an issue for new construction projects, it is important for industry members to evaluate where time and money are being wasted. For Geisinger Gray's Woods Ambulatory Care Campus, numerous approvals and permits delayed the project three months. Specifically, the DEP Act 537 permit was submitted for approval on September 14th, 2006 with approval scheduled for December but was not actually issued until March 1st, 2007. I have found that many other projects throughout the US have experienced this same problem, and at times, encounter an even larger delay from approvals and permits.

Goal:

The goal of researching approvals and permitting and creating an industry survey is to provide possible solutions to alleviate time and cost delays. The focus will be to decide if a standard permitting/approval system will result in positive construction of commercial buildings.

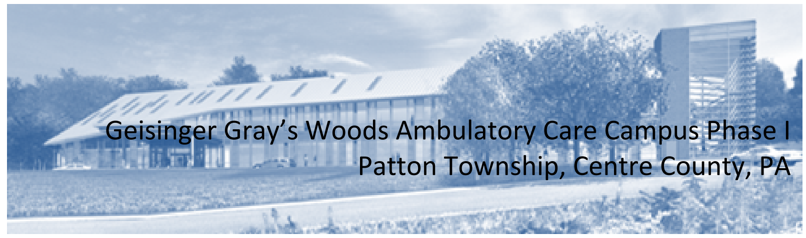
By using other state and county standard permitting systems that have already been instilled, the feasibility of standardizing here in Centre County will be evaluated.

Methodology:

I plan to contact owners, contractors, design professionals, municipalities, region officials, and various government agencies regarding possible solutions to this problem. Also, I would like to speak with attorneys who have dealt with difficult legal construction cases relating directly to delays due to permitting. It will be necessary to research various project types and various state governments. Some focus, however, will cover health facilities in the PA area.

The following are a few questions that would be beneficial to finding a solution:

- Are you responsible for applying for any or all building permits for commercial construction projects?
- If so, what is the most time and money consuming component of the process?
- Are there some permits that are easier to obtain than others?
- What, do you feel, is the best way to deal with permitting to not delay projects?
- If changes were made to the process, do you feel the construction industry would be supportive of the revisions?



Tools:

- Plan Review Officials
- Construction Manager – Alexander Building Construction
- Centre County

Expected Outcome:

Possible solutions to this problem include:

- standardizing permit processes within each state,
- enforcing open lines of communications from owners, contractors and design professionals to permit agency members, and
- authorizing a time constraint for various approval periods.

WEIGHT MATRIX

SECTION VI

The following weight matrix demonstrates the areas of studies and the distribution of effort for the concrete slab and HVAC system technical analyses.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Analysis 1 (Structural) **Normal Weight Concrete Slabs**	-	15%	10%	10%	35%
Analysis 2 (Architectural) **HVAC System**	-	10%	10%	15%	35%
Analysis 3 **Approvals & Permits**	30%	-	-	-	30%
Total	30%	25%	20%	25%	100%

TIME TABLE

SECTION VII

JANUARY 2008						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 WINTER BREAK →	2 →	3 →	4 →	5 →
6 →	7 →	8 →	9 →	10 →	11 →	12 →
13 →	14 Research Lightweight and Normal Weight Concrete →	15 →	16 →	17 →	18 →	19 →
20 →	21 →	22 Redesign of Concrete Slabs and Structural System →	23 →	24 →	25 →	26 →
27 →	28 →	29 →	30 →	31 →		

FEBRUARY 2008						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1 →	2 →
3 →	4 Distribute Industry Survey →	5 →	6 →	7 →	8 →	9 →
10 →	11 HVAC System Analysis and Redesign of Interior Floor Plan →	12 →	13 →	14 →	15 →	16 →
17 →	18 →	19 →	20 →	21 →	22 →	23 →
24 →	25 Evaluate Survey Results →	26 →	27 →	28 Concrete Slab Comparisons →	29 →	

MARCH 2008						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
2 →	3	4	5	6	7	1 / 8 →
9	10 SPRING BREAK – Visit Site to track construction progress	11	12	13	14	15 →
16	17 HVAC Systems Comparisons	18	19	20	21	22 →
23 →	24	25	26	27	28	29 →
30 →	31 →					

APRIL 2008						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 Approvals & Permitting Evaluations	2	3	4	5 →
6 →	7 Finalize Report and Presentation	8	9	10	11	12 →
13 →	14 FINAL THESIS PRESENTATIONS	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			