Adam Finley

Construction Management Option

Technical Assignment 1

The Pennsylvania State University
Health and Counseling Services Building
University Park, Pennsylvania

Table of Contents

Appendix

Executive Summary

This paper will discuss various pieces of information regarding the construction of the new 63,318 square foot Health and Counseling Services Building at The Pennsylvania State University. Key findings of this paper include a milestone evaluation of the project schedule, descriptions of the major elements of the building systems, comparisons of actual and computerized project estimates, site plan evaluation, a look at the construction methods used in the State College area, information about Penn State's expectations for this project, analysis of the project delivery system and the staffing plan used by the construction manager.

Construction began in May 2006 and will be substantially completed in May 2008. Commissioning and occupant move- in will be completed by the end of July so that the building will be ready for use at the beginning of fall semester 2008.

The structural system is a typical moment connection steel frame with a micro pile and grade beam foundation. A glass curtain wall is on the South face that wraps around partially on the East and West sides of the building. The building is five levels with the first level only accessible from the South face due to the sloping grade from North to South.

The mechanical system includes two rooftop air handling units and one indoor air handling unit that will feed only the server room on the first floor. The system uses multiple fan coil units and an array of variable and constant volume boxes to supply enough air to keep the occupants at a comfortable temperature.

Actual construction costs are compared against two forms of generalized estimating software. D4 cost estimating software and R.S. Means Costworks are used to

evaluate the projects costs. These cost analysis show distinct differences between actual and estimated construction costs due to locations, construction methods, and construction materials among other items.

The Whiting- Turner Contracting Company is the lead on this project and holds all of the contracts with the prime contractors. All contracts between the CM and prime contractors are lump sum, while the contract held between Whiting-Turner and the university is CM at risk. The contract between Penn State and Hillier Architects is characterized as a PSU form of agreement 1-P, which is essentially a lump sum contract. Hillier is contracted directly with there consultants.

The project is LEED rated in accordance with the recently adopted Penn State policy to construct green buildings on the University Park campus. At this time, the LEED rating being applied for is a certification.

The owner has multiple concerns about the project. The schedule of work during the winters in state college and the timing of the steel order are examples of potential problems. Proper decisions and management of the project will do well in alleviating these potential pitfalls.

Project Schedule Summary

A preliminary schedule was created to show the basic elements of design and construction. The site work and foundation will be completed during the first winter of 2006 to 2007. Steel erection will continue through the spring of 2007 with elevated slab construction lagging a few weeks behind. The exterior skin and roof will be completed through the summer of the same year. Interior construction will be the last portion of the

work, starting in July 2007 and ending May 2008. A milestone schedule is attached as Appendix A.

Building Systems Summary

Yes	No	Work Scope
	X	Demolition Required
X		Structural Steel Frame
X		Cast In Place Concrete
	X	Precast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
X		Curtain Wall
X		Support of Excavation

Demolition

No demolition is required on this project.

Structural Steel Frame

The structure will utilize a structural steel frame with typical moment connection and non-load bearing masonry and glass curtain walls. Beams and girder sizes range from a minimum of W12 X 14 to W27 X 84 of ASTM A992 steel. The most common size is W16 X 26. Columns utilize a variety of wide flange and hollow structural steel sections.

The steel contractor has been recently awarded, and at this time no structural steel shop drawings are available. There will be bracing required on the project and it is left to the steel contractor to determine which type they will use. At this time, some pieces of steel are of an abnormal size and may need to be upsized for the project to stay

on schedule. A specific crane size has yet to be determined. Due to the limited space available on the site, the crane will be limited to three locations to pick from the staging area and place the steel.

Cast in Place Concrete

Similar to the steel contract, only the foundation concrete has been awarded and the elevated slabs are out to bid. Formwork types have yet to be determined. Concrete placement methods have not been chosen yet either. After speaking to the Penn State Project Manager, Chad Spackman, he believes that the building will use a pumped placement system for the concrete. There is the potential for a concrete chute to be used for the elevated slabs later in the project, when the steel contractor has a crane on site.

Precast Concrete

No precast concrete will be used on this project.

Mechanical System

The mechanical system consists of two rooftop air handling units supplying 37,500 CFM each to the entire building. A server room, located on the third floor is maintained by an indoor air handler that supplies that room alone. The supply air is distributed via a network of variable volume boxes. Fan coil units and constant volume boxes help to supply some areas of the building. The South face of the structure uses radiant heat located in ceiling panels. This was done to eliminate the unpleasant aesthetic of baseboard heating against the glass curtain wall. The fire alarm suppression system is primarily wet with a dry system currently designed for the server room. An add alternate is being reviewed to place a preaction system in the server room.

Electrical System

The electrical system is supplied from the utility at 277/480V at 1600 Amps. The voltage is stepped down through a series of transformers to supply fluorescent and incandescent light fixtures, outlets and other various devices as needed. The building has emergency power, supplied by the campuses emergency/ standby system, with an automatic transfer switch located adjacent to the main electrical room.

Light fixtures throughout the building are typical, incandescent and fluorescent, but in most rooms tied into an occupancy sensor that will turn off lights if there is no movement within the room for a predetermined amount of time. This sensor saves energy and money over the life of the building, and also is a credit towards the projects LEED certification.

An interesting feature of this system is it's capability to have full backup power for half of one floor if the power was to go out. This was incorporated into the design so that the clinicians would still have the ability to treat patients in emergency situations. Penn State is also looking at two add alternates, to have the capability to manually turn on another floor's power and the operation of the entire building in an emergency where the utilities service was interrupted.

Masonry

The skin of the building is a combination of brick veneer and a glass curtain wall. A detail of the masonry connection to the structural frame is not yet available due to incomplete specifications. Generally speaking, a mechanical fastener between the structural system and brick veneer is required where masonry elements are adjacent to

structural framing. Anchors are not to exceed 16” O.C. and should be able to support a horizontal load of not less than 500 lbs. A scaffolding system has not yet been approved.

Curtain Wall

The curtain wall, glass, metal panels, and glazing will all be awarded under one prime contract. The basis of the curtain wall design is a Vistawall CW-250 system. The system can adjust its interior mullion depths for aesthetic and loading requirements. Heavy duty vertical mullions can be implemented for larger structural loads depending on the size and requirements of the system. This system is not load bearing and will not require this option to be implemented.

Construction of the system will use the butt glazed method. The system uses few parts allowing for less confusion on the job site leading to quicker and cheaper installation. Vistawall also uses pre-punched pressure plates to allow for easier installation.

Support of Excavation

Dewatering of the site will be required, but only temporarily during the construction. The North end of the building has a drainage system incorporated into the design since the 1st floor of the structure will be partially below grade. During the excavation and the foundation work phases, shotcrete will be applied to the unearthed walls. This system was chosen because it is relatively cheap and it has the ability to be placed quickly. While an unconventional approach, Whiting- Turner’s project manager has experience with this method of supporting excavated walls.

Project Cost Evaluation

The overall project cost is $24 million dollars. The approximate cost of construction is $17.1 million dollars. This number is approximate due to the limited number of subcontracts that have been awarded contracts at this time. Site work/ Excavation, Minipiles, Foundation concrete, and Structural steel packages have been awarded, while other major systems will be awarded in the coming weeks.

Construction and Project Costs

Type	Cost	Cost/ S.F.
Construction Cost	$17,100,000.00	$270.00
Project Cost	$24,000,000.00	$379.00

Contract Costs

Contract	Cost	Cost/ S.F.
Site work/ Excavation	$678,000.00	$10.71
Minipiles	$446,355.00	$7.05
Foundation Concrete	$480,000.00	$7.58
Structural Steel	$1,703,220.00	$26.90
Mechanical	N/A	N/A
Electrical	N/A	N/A
Elevated Concrete	N/A	N/A

The D4 cost estimate showed a roughly 7 million dollar difference between actual and estimated construction costs. The data that was available at the time of the estimate from awarded contracts was substituted into the D4 estimate. The building used as a comparison was the five story Sylvester Comprehensive Cancer Center that is located in

Miami, Florida. This building was constructed in 1990 over a period of three years and has the same basic major structural and building envelope systems as the new Health Services Building.

The cost difference between these two buildings can be attributed to multiple factors. The inflation between 1990 and 2006 is the first obvious factor. The new health services building is LEED rated and its construction cost will be slightly higher due to the requirements required of that goal. The cancer center does not employ a glass curtain wall. While this price is not yet known, the curtain wall/ brick veneer combination should be more expensive to install than a conventional brick veneer system.

The Costworks estimate used a 2-4 story office building with a glass curtain wall and structural steel frame, obtained from the program Costworks (copyright 1996-2004 Costworks CD R.S. Means Co., Inc.). This estimate can be viewed in more detail in Appendix D. This model type was chosen because it most closely resembled the design of the new Health Services and Counseling Building. The Costworks estimate gave a construction cost of $6,666,350.00 and is well below the $17,100,000.00 price tag of the actual construction. This can be attributed to multiple factors. The Costworks estimate was for a 3 story structure that had a much smaller square footage. Also, the office building estimate does not include the major amounts of equipment that a medical and teaching building need, such as x-ray machines, lab equipment, and seating areas.

Local Conditions

The preferred methods of construction in State College, Pennsylvania, more specifically on the University Park campus, are steel frames with masonry brick veneer and glass curtain wall exteriors. Floor construction is mostly metal decking with welded

wire mesh or rebar. Micro piles and grade beams are typical of foundations in the area. This is due to the existing subsurface ground conditions.

The subsurface of the proposed site and surrounding properties is primarily bedrock formations, classified as the Nittany Formation. This bedrock is composed of fine and coarse crystalline dolomite, with areas of cherty dolomite. The region has an overabundant amount of clay that is found above this bedrock formation. Usable soil for building construction is usually not found within construction sites. The formation of sink holes is common in the area due to this bedrock formation. The bedrock, quite frequently, has caverns below what is found in initial surveys. When the bedrock is loaded with the structure it can give way into the cavern causing the sinkhole formation.

Local recycling centers are found in Lewistown, Pleasant Gap, Snowshoe, and Bellefonte, Pennsylvania. These centers mostly take scrap iron, aluminum, brass, copper, and steel. Only one local recycler accepts cardboard and paper products. All other materials that will need to be recycled on this project will have to be transported out of the local area. To maintain the LEED certification goal on this project the construction manager will need to make arrangements to move past this obstacle.

Parking on-site by tradesmen and most of the construction manager's staff is not permitted. This is due to the limited number of parking lots and parking spaces for the students, staff, and faculty of the university. Construction parking is provided at Lot 44, which is located south of Beaver Stadium. Transportation to and from the site for the construction manager and prime contractors is not provided under the contract and is the responsibility of the individual contractor to make proper arrangements.

Client Information

The owner is The Pennsylvania State University. The new Health and Counseling Services Building is being constructed for multiple reasons. The existing facility, Ritenour Building, is undersized for the growing demands of an ever increasing student community. Ritenour Building was built in 1929 to accommodate a population of approximately 4,000 students. Multiple additions and renovations have been completed to the structure, but as of 2006 the facility is incapable of supporting the 40,000 strong student population at the same level of care that it once was able to.

The new structure, that is almost 64,000 square feet and capable of holding 614 people will be able to support the community for generations to come. Other factors that have encouraged the development of this building include not having enough space for each clinician, a counseling service that is one of the largest in the country having only one group room and utilizing a hallway as part of its space, overcrowded waiting services that spread disease, a pharmacy that is too small, and privacy issues with spaces being used for applications never intended.

As an experienced owner O.P.P., Penn State's representing division known as the office of physical plant; has expectations for a high quality project that is on time and within budget are of great importance. O.P.P. knows that safety is an important factor in any project from marketing, ethical, and litigation standpoints. O.P.P. will not compromise safety for any expectations they may have about the construction, and

therefore have incorporated guidelines above and beyond OSHA requirements for all projects on Penn State campuses.

Chad Spackman, Penn State's representative, is concerned about the overall project schedule and it's affect on the health services at the university. The need to keep Ritenour Building operational while moving the facility into the new structure will be an extreme challenge. Another concern are the bids that will be received for portions of the work that were value engineered. Due to a tight budget, a large amount of value engineering was incorporated into the design process. The estimated value of the buildings systems need to remain constant due to this situation. Bids that come in above these estimates will be negotiated with the contractor to fit within this price or extra value engineering may need to be added into the design. The last of Mr. Spackman's concerns is the timing of the steel order. At this time, some pieces of steel that are in the project are an odd size and will need to be coordinated with the steel mill. Many steel mills have been contacted about these structural elements, and at this time the mills would not be able to accommodate a steel order for these sizes for on schedule delivery. Over sizing the steel may occur so that they can be purchased from a regional distribution warehouse.

There are a small number of scheduling concerns for this project. The concrete work will be placed during the winter in State College. Quality control will need to be performed to ensure that all concrete has cured to the designed strength. The curtain wall, on the South face, is another important issue that may need to be addressed. The manufacturer has informed Penn State and Whiting- Turner that the lead time for this curtain wall system may impact the current schedule due this systems long lead time status.

The success of this construction in Penn State's eyes will be dependent on multiple factors. As a rule, all owners consider a high quality project that is on schedule and on budget with no safety incidents a successful project. Penn State challenges its general contractors and construction managers to take safety more seriously than other owners they have worked with previously. Specifically, fall protection and the covering of open holes from the pedestrians are of high importance to the university and O.P.P.

Another issue is the need for a properly constructed and commissioned mechanical system that will pass air balancing in a timely manner. Many recent projects at the campus had issues with the mechanical systems not passing the commissioning process on multiple attempts. Mr. Spackman has made it known that this is not acceptable on the Health and Counseling Services Building.

Project Delivery System

The main utility work was performed outside of the scope of this project, due to time constraints. Sweetland Engineering made the document and Stove Valley Construction performed the utility sub-grade work. This was done so that the building construction side of the project could remain on a scheduled completion date of July 2008.

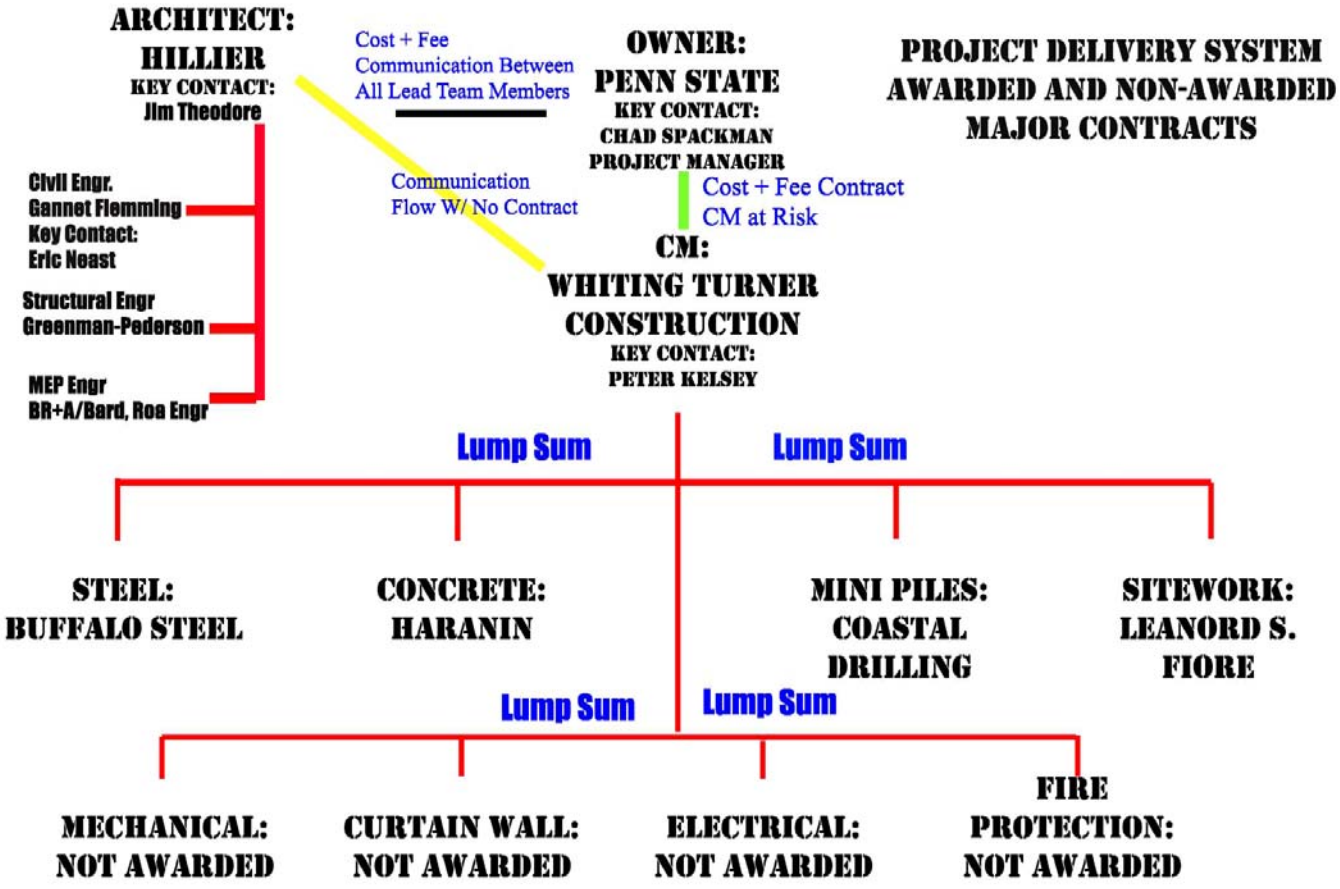
Hillier Architecture holds a cost plus fee contract with Penn State to design the structure and the building systems. The project construction is being coordinated by Whiting- Turner and constructed by its prime contractors. Whiting-Turner holds a CM at Risk contract with Penn State. That is to say the construction manager holds all contracts with the prime contractors that are actually constructing the building and therefore holds

all the risk on the project. A chart showing how this delivery system is set up can be seen on page 16.

The contract between Penn State and Whiting-Turner includes specific requirements for insurance, local and national laws that govern construction, submittal process, request for information processes, change order processes, scope, coordination and communication between all parties, scheduling and completion dates, and miscellaneous owner requirements. Penn State has items in the document that are site and location specific. For example, plant, land protection and LEED goals. One interesting item is that Penn State and their respective project management team have the right to take control of the project and the prime contactors if at any point Whiting-Turner is found to be incapable or unwilling to fill their contract. Whiting-Turner and their sub-contractors have similar contractual agreements. Less detail is provided in these areas, but more specific scope packages are defined between the CM and the respective specialty trades.

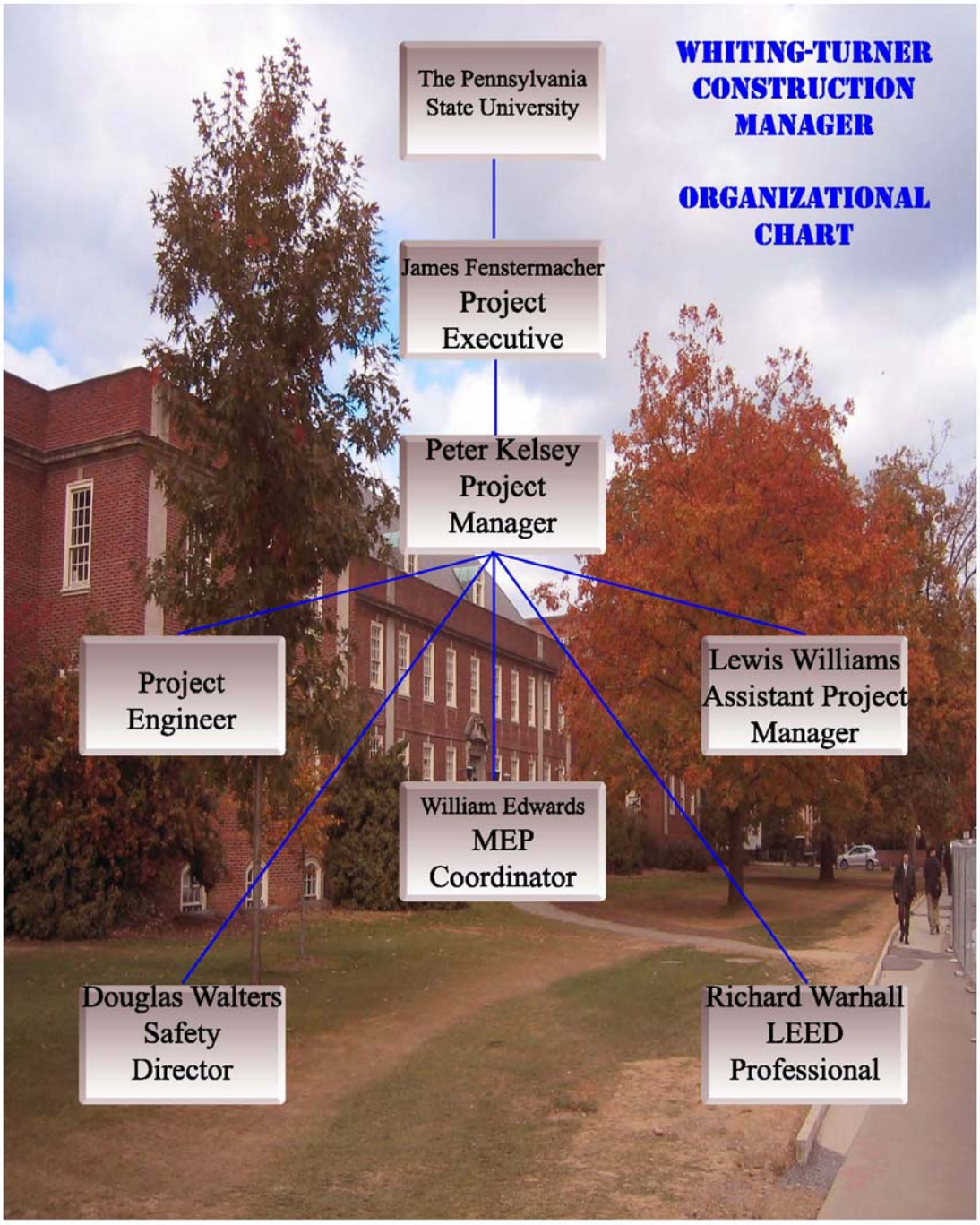
All sub-contractors that were sent invitations to bid are on a pre-qualified bidders list that Penn State requires all contractors that work on their campuses to apply for and be accepted into. Penn State requires this because the forms that must be filled out about insurance, bonding and surety agencies, previous projects, etc. help to eliminate the submission of bids from unqualified contractors. At this time, all bids received have been chosen by the lowest bid method. Although Penn State reserves the right to choose any bid it wishes for any reason, it has decided to work with the lowest bid and then make sure a full scope was included in the lump sum price.

Bid bonds at five percent are required of all bidders. This bond will be forfeited to the owner any time an awarded contractor can not fulfill their obligation to the project. Performance and Payment bonds are also required. These bonds are also added on the bidding form as an alternative to deduct from the price supplied by the contractor.



Staffing Plan

The following organizational chart shows how Whiting- Turner is assigned to the project.



During the estimating and preconstruction phases, James Martini, a vice president of Whiting- Turner was the project executive on Health Services. James Fenstermacher held senior project manager status and oversaw the MEP coordinator, LEED accredited professional, senior scheduling manager, Director of safety, and two project managers working on the University Park campus. These two project managers are Keith Jarvis who will be the project manager on the Life Sciences 2 building and Peter Kelsey who is the project manager on the new Health and Counseling Services building.

Upon mobilization at the construction site, the organizational structure changed to the diagram shown on page 17. The Vice President, James Martini, has left his role as the project executive and James Fenstermacher has taken on that role. All of the technical support such as MEP coordinator, Director of safety, etc. has been given to Peter Kelsey to oversee and coordinate during the construction process.

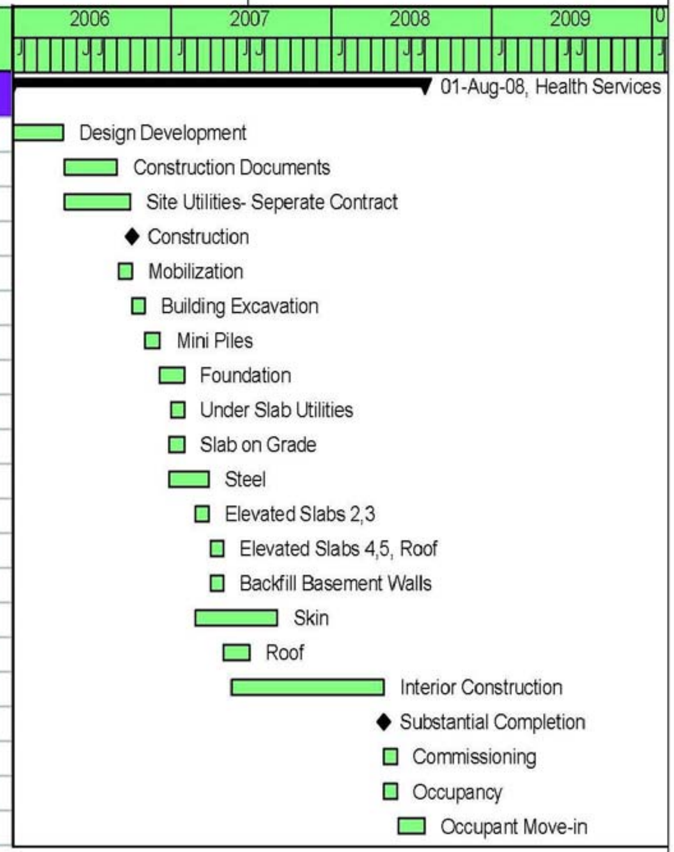
Appendix

Appendix – A

Milestone Schedule

Health and Counseling Services Building | Classic WBS Layout | 02-Oct-06 16:33

Activity Name	Original Duration	Start	Finish
Health Services	667	03-Jan-06	01-Aug-08
Design Development	85	03-Jan-06	01-May-06
Construction Documents	87	02-May-06	01-Sep-06
Site Utilities- Seperate C	106	02-May-06	29-Sep-06
Construction	0	02-Oct-06*	
Mobilization	20	05-Sep-06	02-Oct-06
Building Excavation	23	03-Oct-06	02-Nov-06
Mini Piles	21	03-Nov-06	05-Dec-06
Foundation	40	06-Dec-06	01-Feb-07
Under Slab Utilities	23	02-Jan-07	01-Feb-07
Slab on Grade	24	29-Dec-06	01-Feb-07
Steel	64	29-Dec-06	29-Mar-07
Elevated Slabs 2,3	22	28-Feb-07	29-Mar-07
Elevated Slabs 4,5, Roof	22	30-Mar-07	30-Apr-07
Backfill Basement Walls	22	30-Mar-07	30-Apr-07
Skin	132	28-Feb-07	30-Aug-07
Roof	44	01-May-07	29-Jun-07
Interior Construction	248	21-May-07	30-Apr-08
Substantial Completion	0		30-Apr-08
Commissioning	22	01-May-08	30-May-08
Occupancy	22	01-May-08	30-May-08
Occupant Move-in	45	02-Jun-08	01-Aug-08



Actual Work | Critical Remaining ... | Remaining Work | Milestone

Page 1 of 1 | Adam Finley- October 5,2006

Appendix – B

Site Plan

Appendix – C

D4 Cost Estimate

Health Services

Case Number	09011983
Project Name	Health Services
Project Cost	$9,906,052.00
Site Size	63318
Building Use	Medical
Bid Date	9/1/2006
Num Floors	5
Read Only	False
Historic	False
Base Month	Sep
Base Year	2006
Base Location	PA - State College
Projected Month	Aug
Projected Year	2008
Projected Location	PA - State College
Building Size	63318
Project Height	60
1st Floor Height	12
1st Floor Size	12664
Foundation	CON
Exterior Wall	CUR
Interior Wall	GYP
RoofType	MEM
Floor Type	CON
Project Type	NEW
By Contact	Adam Finley
By Firm	Penn State AE
By City	State College
By State	PA
By Zip	16803
For Contact	Dr. Michael Horman
For Firm	Penn State Advisor
For City	State College
For State	PA

Code	Division Name	%	Sq. Cost	Projected
00	**Bidding Requirements**	**0.00**	**0.00**	**0**
	Bidding Requirements	0.00	0.00	0.00
01	**General Requirements**	**7.75**	**12.99**	**822,312**
	General Requirements	7.75	12.99	822311.90
03	**Concrete**	**13.65**	**22.89**	**1,449,440**
	Concrete	13.65	22.89	1449440.22
04	**Masonry**	**4.60**	**7.70**	**487,843**
	Masonry	4.60	7.70	487843.47
05	**Metals**	**17.16**	**28.77**	**1,821,739**
	Metals	17.16	28.77	1821739.13
06	**Wood & Plastics**	**4.91**	**8.24**	**521,452**
	Wood & Plastics	4.91	8.24	521452.00
07	**Thermal & Moisture Protection**	**1.17**	**1.96**	**124,155**
	Thermal & Moisture Protection	1.17	1.96	124155.24
08	**Doors & Windows**	**4.25**	**7.12**	**451,001**
	Doors & Windows	4.25	7.12	451001.12
09	**Finishes**	**9.60**	**16.10**	**1,019,343**
	Finishes	9.60	16.10	1019343.38
10	**Specialties**	**0.65**	**1.09**	**68,718**
	Specialties	0.65	1.09	68718.48
11	**Equipment**	**1.51**	**2.54**	**160,742**
	Equipment	1.51	2.54	160742.05
12	**Furnishings**	**3.03**	**5.08**	**321,484**
	Furnishings	3.03	5.08	321483.74
13	**Special Construction**	**0.44**	**0.73**	**46,197**
	Special Construction	0.44	0.73	46197.30
14	**Conveying Systems**	**2.32**	**3.89**	**246,578**
	Conveying Systems	2.32	3.89	246578.08
15	**Mechanical**	**18.34**	**30.75**	**1,947,216**
	Mechanical	18.34	30.75	1947216.11
16	**Electrical**	**10.62**	**17.80**	**1,127,214**
	Electrical	10.62	17.80	1127214.07
	Total Building Costs	**100.00**	**167.65**	**10,615,436**

Project Notes

Estimate Based On Case: MD930704 - Sylvester Comprehensive Cancer Ctr.
Location: FL - Miami
Date: Feb 1990
Building Size: 117,500

*Miami, Florida
*Construction Period Mar 89 to May 92

Site is bounded on two sides by intersecting main arterial streets, one of which is dominated by the elevated Miami Metrorail.

Land provided for a courtyard and a main entrance for the institution. Courtyard is intended to be the hub of activity, which links the existing medical campus buildings.

5 story atrium space pulls the courtyard into the heart of the building. Atrium serves as the focus of activity in the center and forms an alternate entry to the campus from the public street.

Color, detailing and materials palate of the courtyard and building exterior were woven into the atrium carpet and terrazzo patterns.

Appendix – D

Costworks Estimate

Costworks 2005

Preliminary Cost Report

Project Name: [No Active Project]

Model Type: Office, 2-4 Story, Glass and Metal Curtain Wall / Steel Frame

Stories (Ea.): 3		Location:	State College, PA
Story Height (L.F.): 12		Data Release:	2005
Floor Area (S.F.): 63318		Wage Rate:	Union
Basement: Not Included			

Costs are derived from a building model with basic components. Scope differences and local market conditions can cause costs to vary significantly.

		$Cost/ Per S.F.	$ Total Cost	% Of Sub-Total
A Substructure				4.6%
A1010	Standard Foundations	1.59	100,500.00	
A1030	Slab on Grade	1.26	79,500.00	
A2010	Basement Excavation	0.07	4,600.00	
A2020	Basement Walls	0.68	43,100.00	
B Shell				26.8%
B1010	Floor Construction	11.06	700,000.00	
B1020	Roof Construction	2.30	145,500.00	
B2020	Exterior Windows	5.84	369,500.00	
B2030	Exterior Doors	0.65	40,900.00	
B3010	Roof Coverings	1.27	80,500.00	
C Interiors				23.5%
C1010	Partitions	2.04	129,000.00	
C1020	Interior Doors	2.88	182,500.00	
C1030	Fittings	0.98	62,000.00	
C2010	Stair Construction	2.13	135,000.00	
C3010	Wall Finishes	0.89	56,500.00	
C3020	Floor Finishes	5.72	362,000.00	
C3030	Ceiling Finishes	3.87	245,000.00	
D Services				45.1%
D1010	Elevators and Lifts	9.89	626,500.00	
D2010	Plumbing Fixtures	1.39	88,000.00	
D2020	Domestic Water Distribution	0.06	4,025.00	
D2040	Rain Water Drainage	0.08	4,825.00	
D3050	Terminal & Package Units	13.35	845,500.00	
D4020	Standpipes	0.21	13,400.00	
D5010	Electrical Service/Distribution	0.99	62,500.00	
D5020	Lighting and Branch Wiring	8.84	560,000.00	
D5030	Communications and Security	0.63	40,200.00	
D5090	Other Electrical Systems	0.05	3,300.00	
	Sub-Total	78.72	4,984,350.00	**100%**
	GENERAL CONDITIONS (Overhead & Profit) 25%	19.68	1,246,000.00	
	ARCHITECTURAL FEES 7%	6.89	436,000.00	
	USER FEES 0%	0.00	0.00	
	TOTAL BUILDING COST	105.28	6,666,350.00	