

November 4, 2010

TECHNICAL ASSIGNMENT TWO

PENN STATE AE SENIOR THESIS



SUPPORT SERVICES BUILDING

PENN STATE MILTON S. HERSHEY MEDICAL CENTER – HERSHEY PA

WILL LAZRATION

CONSTRUCTION MANAGEMENT

DR. RILEY





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EXECUTIVE SUMMARY

Technical Assignment Two is intended to analyze key schedule, site logistics, structural system & general conditions costs, features and parameters that influenced the project execution of the new Support Services Building at the Penn State Milton S. Hershey Medical Center. Included in the scope of work is the construction of a new 42,796 SF medical warehouse/office/support services building as well as the re-alignment of Lion Life Drive with Campus Drive. Unique challenges associated with this project are the small odd-shaped proposed site and construction above the existing utility tunnel that houses the main steam and chilled water lines for the main hospital. An added complexity to the project is maintaining traffic while constructing the road-realignment.

Construction of the new Support Services Building started on June 14th 2010, and final completion is currently scheduled for September 30th, 2011. More detailed information regarding the construction schedule and phases of construction is shown within the **Detailed Project Schedule** section of this report. Included in the section is a detail project schedule (APPENDIX A) to better depict the sequencing of trades throughout the project.

Key to the success of the project is the organization of subcontractor's and materials onsite for each phase. Actual construction of the Support Services Building was broken down into three distinct phases; Sitework, Shell & Enclosure, and Interior Fit-out. Sitework was also then broken down into building sitework and road re-alignment. A more detailed look into the layout of the site during the Shell & Enclose phase and phases of the road re-alignment can be found in the **Sit Layout Planning** section.

A complete detailed quantity take-off was performed on both the concrete and steel structural systems. Total take-offs yielded 1900 CY of concrete and 258 tons of structural steel on the project. Total estimated costs for the two systems were found to be \$682,771 (\$359.35/CY) for the concrete system and \$756,389 (\$2,932/ton) for the structural steel system. A more detailed look into the breakdown of costs associated with each estimate can be found in the **Detailed Structural System Estimate** section. Both estimates were found to be within 6% of the actual construction costs respectively.

Alexander Building Construction Co. from Harrisburg, Pa is the construction manager at risk on the project. In order to oversee construction of the project, a team of experienced construction personnel will be employed on the project. A general conditions estimate was developed in order to show projected costs for personnel, construction facilities/equipment, temporary utilities/services and miscellaneous project costs. In total for the 15 month project duration, the general conditions were found to be \$928,435.00 or \$61,896/month. Unique to the Support Services Building project, it was found that Personnel comprised over 87% of the total general conditions costs. A more detailed explanation of why Personnel comprises the majority of the general conditions costs and a more detailed breakdown of items within the general conditions estimate can be found in the **General Conditions Estimate** section.

Both students and industry experts attended the 19th annual PACE Roundtable held at the Penn State Conference on October 27-28, 2010. A brief summary of key issues discussed in the *Technology Applications* break-out sessions is included in the **Critical Industry** Issues section.



DETAILED PROJECT SCHEDULE

* See APPENDIX A for Detailed Project Schedule

*Detailed Project Schedule is Based on Alexander’s Original Construction Schedule

Beginning March 1st 2010 The Pennsylvania University & The Penn State Milton S. Hershey Medical Center began interviewing construction management firms for preconstruction & construction services for the Support Services Building to be built on the Hershey Medical Center campus (1st line item of Detailed Project Schedule in Appendix A). Shortly after on March 15th 2010, Alexander Building Construction Co. from Harrisburg, PA was selected as the CM. With a CM selected the project went before the University Board of Trustees and on March 19th 2010 final approval was given. A summary of the entire project timeline is shown below in Figure 1.



Figure 1: Summarized Project Timeline

Ground was broken on the Support Services Building on June 14th 2010 with site clearing and site utilities continuing throughout the entire month of June. Construction of the Campus Drive Realignment began on June 28th 2010 and by September 24th 2010 the new road was open to traffic.



Figure 2: Grade Beams & Foundation Walls at East Side of Building

Micropile installation began on the 1st of July and was followed by cast-in place concrete foundations components. Figure 2 at right shows completed concrete foundation elements with waterproofing applied, ready for backfill as of October 22nd 2010. Due to issues with the micropile installation, the project is currently a week behind the original schedule dates. However, steel erection is still currently scheduled to begin at the end of October and be completed by Thanksgiving. It is during this time, the lost time due to micropile installation will be made up. After steel erection is complete, the exterior enclosure will start and continue throughout the winter and into the spring of 2011.

Starting right after the New Year is the interior fit-out. Currently the schedule shows the 2nd level starting first with the 1st level lagging the 2nd by three weeks. Physical construction is scheduled to be completed by the end of July 2011. The entire month of August 2011 is scheduled for final cleaning, testing & balancing, and final inspections. Substantial completion is scheduled for August 31st, 2011. Upon receiving substantial completion Alexander has devoted the month of September for commissioning, owner training, and movement of the owner’s equipment/furniture into the building. Final completion/Hospital Occupancy is scheduled for September 30, 2011. This date set by HMC, is the only milestone in which Alexander must hit. However it is vital they keep to their current schedule to insure they hit that date. After final completion the current schedule shows the building receiving its LEED Certification by the end of January 2012.



SITE LAYOUT PLANNING

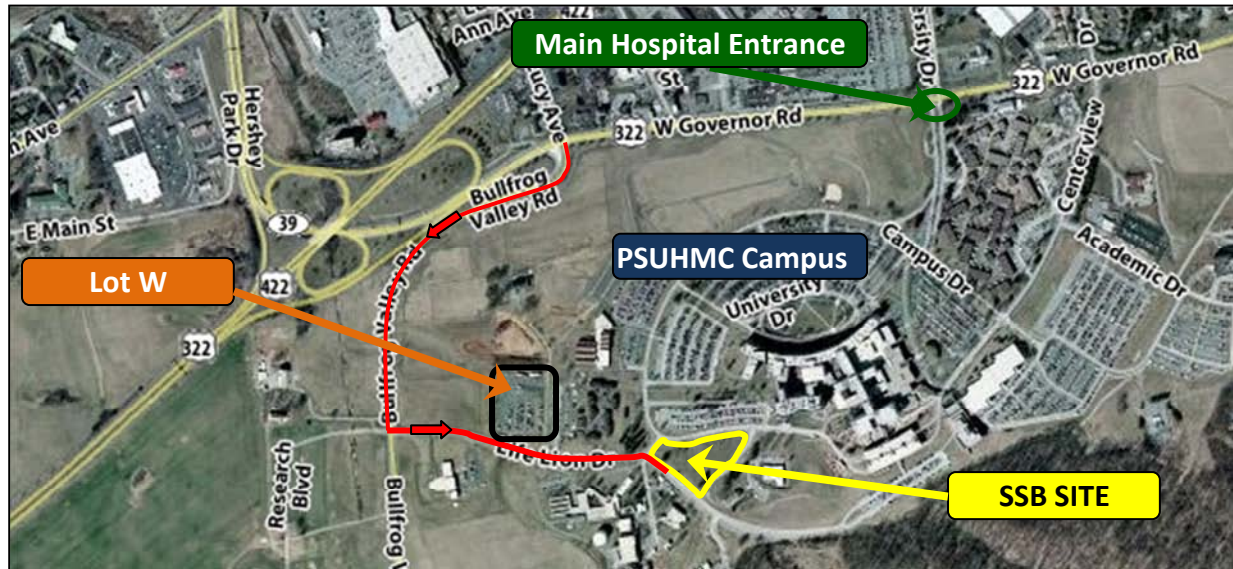


Figure 3: Construction Access to Support Services Building Site. Image taken from Yahoo maps

As shown above in Figure 3 the Support Services Building is being built on a triangular shaped site on the southwestern part of the Penn State Milton S. Hershey Medical Center's campus. To eliminate congestion at the main entrance to the Hospital, the primary construction access is from the west off Bullfrog Valley Road. Secondary access for smaller (personal) vehicles however is not restricted. Unique to any project on the medical centers campus, large deliveries are prohibited during specific hours (6:30A.M-8:30A.M & 3:30P.M.-6:00P.M.) in order to keep congestion down during shift changes. Also, due to the fact that Hershey Medical Center is a major medical research facility that's serves a major portion of central Pennsylvania, parking in the hospitals parking lots is strictly prohibited to contractors. With the odd shape of the Support Services site space is a premium, so to alleviate congestion onsite, many of the subcontractor's trailers and parking will be in Lot W (see Figure 3 above) off Lion Life Drive. The lot will also be utilized as a construction staging area.

Based on the Detailed Construction Schedule, construction of the Support Services Building is broken up into 3 major phases; Sitework, Shell & Enclosure (includes superstructure), and Interior Fit-Out. Included in the Sitework phase is the road re-alignment of Lion Life Drive with Campus Drive which required phasing in order to maintain access to the hospital. In this report, the site plan for Shell & Enclosure and the three phases of the road re-alignment will be discussed with further detail.

SHELL & ENCLOSURE PHASE

*** See APPENDIX B for Shell & Enclosure Phase Site Layout Plan**

During the Shell & Enclosure the site is more congested than any other phase on construction. This is largely due to the amount of exterior work taking place. Structural steel will be erected using a 100 ton crawler crane located on the south side of the building. Vital to the success of the crane is the crane tracking area. This 35-foot wide path has to be free of obstructions in order for the crane to track back and forth during erection. It also has to be fairly level in order for the crane to be stabilized. To achieve this, the base course of asphalt paving will be installed in all three of the new parking lots prior to steel

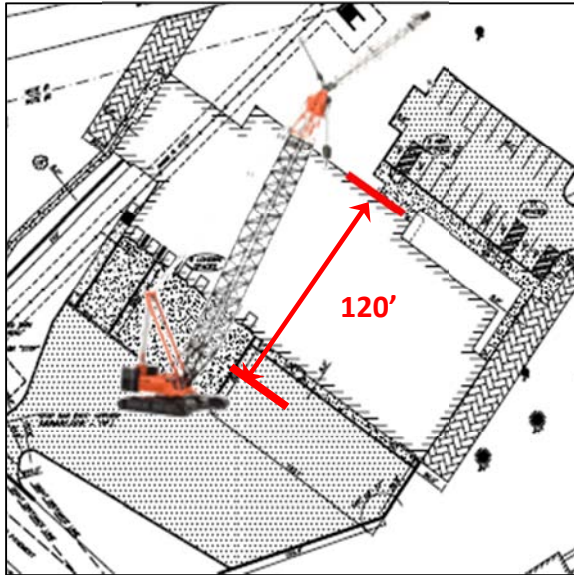


Figure 4: Longest Reach for 100 ton Crawler Crane

erection. Reach will not be an issue for the crane from the south side. The longest pick (shown in figure 4 at right) is just over 120'. With the heaviest piece of steel being just over 2 tons, this is more than manageable. Once steel erection is complete, the area once taken by the crane will be utilized as more storage/lay-down area, but yet still leaving access to the western loading docks.

Space will be available onsite for limited material storage and lay-down areas for all contractors but the exact amount and location will be coordinated with Alexander's Superintendent. Typically material necessary for the week's activities will be stored onsite with all other materials being stored in Lot W. Space will also be available in the western parking lot for subcontractor's office trailers and parking, but again is limited and all overflow will utilize Lot W.

Due to the number of exterior CMU walls, stone veneer, and metal panel cladding a 15-foot area around the perimeter of the building has been reserved for scaffolding /all-terrain man-lifts necessary for installation of the finishes. Using the functional components of the building is also a key to all phases on construction. On the south side of the building there are eight loading docks that will be utilized as material and personnel access to the building.

ROAD RE-ALIGNMENT PHASES

Along with the construction of the new Support Services Building, Alexander's scope of work also included the re-alignment of Lion Life Drive with Campus Drive. As seen in figure 5 at right, vehicles on Lion Life Drive have to wait at a stop sign and let vehicles on Campus Drive pass before turning left onto Campus Drive. With Lion Life Drive being the only access point to the hospital from west, the intersection quickly backs up during shift changes at the medical center. It was made clear from day one by the medical center that construction of the re-alignment had occur without closing access from existing west.

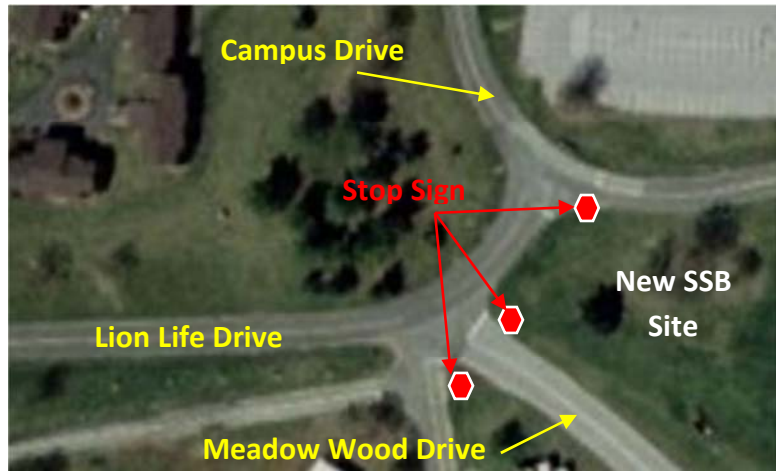


Figure 5: Existing Intersection Between Lion Life Drive & Campus Drive

Immediately after the sitework subcontractor (Liberty Excavators) was selected, they sat down with Alexander and started developing phasing diagrams in order to figure out exactly how they were going to accomplish the re-alignment without shutting down the road. After closer examination, it was decided that since re-alignment involved three major roads, each road/intersection would be treated as



a phase and constructed accordingly. It was this plan that the medical center eventually signed off on and allowed construction to begin. Figures 6, 7, & 8 below show all three phases of the final plan.

Phase one is the largest phase of the three and it ties Lion Life Drive into Campus Drive. Because sections of this phase overlap the existing roadway, extra phasing was required in order to maintain traffic flow. Liberty Excavators plan was to complete the base course of asphalt paving in the areas shown in red below in figure 6 first. Then utilizing flaggers along the existing road, they would install the wearing course of paving one lane at a time. Once completed, traffic was able to flow smoothly from Lion Life Drive onto Campus Drive

Phase two although smaller than phase one, was more complex. It involved the construction of a temporary roadway (shown in light green in figure 7 below) to allow traffic from ARF Drive and Meadow Wood Drive to be maintained. Also in phase two, Liberty Excavator’s plan was to demolish the remaining portion of the existing roadway that was replaced.

Phase three was the smallest of the three and involved the final tie-in of Campus Drive. Again the same temporary roadway was utilized to maintain traffic from the east on Campus Drive. Upon completion of the asphalt paving, the temporary roadway was removed and all roads were now open to traffic. Lastly a landscaper was brought in and the whole area was re-planted with grass and trees.

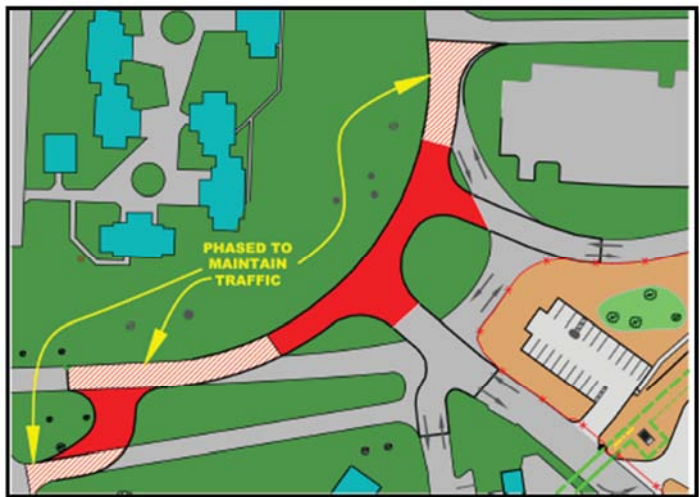


Figure 6: Phase 1 of Road Re-Alignment

KEY	
CONSTRUCTION	Red
TEMPORARY	Green
COMPLETED	Yellow
DEMOLITION	Blue



Figure 7: Phase 2 of Road Re-Alignment



Figure 8: Phase 3 of Road Re-Alignment



DETAILED STRUCTURAL SYSTEM ESTIMATE

* See APPENDIX C for complete Detailed Structural Steel Estimate

Acting as the backbone for the Support Services Building, the superstructure is comprised of both cast-in-place concrete and structural steel elements. Cast-in-place elements include; pilecaps, gradebeams, foundation walls, piers, and both elevated slabs & slabs-on-grade. Using a complete detailed set of construction documents and given the smaller size of the Support Services Building with no typical modules (bays), a complete detailed estimate was performed in lieu of a modular estimate. As shown below in Table 1, both the structural and the CIP concrete estimate were within 6% of actual construction costs when similar line items were compared. Using the available information, it is felt that the two estimates are more than reasonable given the parameters and expectations of the assignment.

	Estimated	\$/Unit	Actual	\$/Unit	
Estimate	Total:		Total		% Different
CIP Concrete	\$682,770.68	\$359.35/CY	\$718,936.00	\$378.39/CY	5.03
Structural Steel	\$756,388.69	\$2,931.54/ton	\$716,381.00	\$2,761.17/ton	5.8

Table 1: Estimated vs. Actual Cost Comparison

Although only 42,796 SF, the Support Services Building is fairly complex in its own ways. First there are no typical bays located within the structure. Second, the superstructure of the building utilizes 38 different steel wide flange and hollow tube steel sections. In total, all of the different wide flange and HSS beams and columns totaled 258 tons of structural steel. Due to the karst bedrock formation in the area and the potential for sinkholes, 1,900 CY of concrete was utilized to anchor the building to the ground and keep it from settling. Table 2 below summarizes a more detailed breakdown of quantity and costs per CSI Masterformat for each component in the estimate.

CSI Code	Component	Unit	Unit Cost	Quantity	Cost
032000	Concrete Reinforcing	Ton	\$478.61	293.16	\$140,310.65
033000	CIP Concrete	CY	\$123.09	1,900	\$233,864.32
031000	Concrete Formwork	SFCA	\$30.24	9,938*	\$300,521.30
033510	Polished Concrete Floors	SF	\$.40	20,186	\$8,074.40
051200	Steel Beams and Girders (A992)	Ton	\$2,286.42	147.1	\$336,331.84
051200	Steel Columns (A992)	Ton	\$1953.05	98.6	\$192,571.22
052100	Steel Roof Joists	Ton	\$1,919.71	12.6	\$24,188.39
053100	Metal Floor Decking	SF	\$2.85	20,000	\$57,000
053100	Metal Roof Decking	SF	\$2.05	25,330	\$51,926.50
055000	Miscellaneous Steel Items	-	-	-	\$94,370.74
TOTAL:					\$1,439,159.37

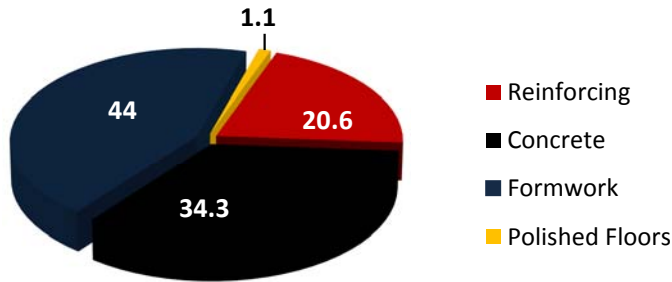
Table 2: Estimate Summary

*Note: Aluminum Panel formwork was used on project. Figure represents total amount of formwork required/2.5 to account for reuse of formwork.

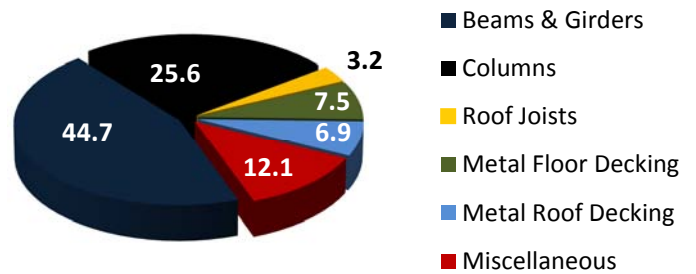
To further see the distribution of costs associated with each estimate, Figures 9 & 10 on the next page represents each estimate broken into individual components. As expected formwork comprises nearly 45 percent of the total CIP Concrete estimate due to the large amount of labor associated with assembling and de-assembling the aluminum form panels. Beams and girders also comprise nearly 45% of the total Structural Steel estimate which makes sense due to the number of beams/girders when compared the other components.



CIP Concrete Estimate



Structural Steel Estimate



Figures 9 & 10: Percent Breakdown of Estimate Components

In order to produce an accurate estimate several factors and assumptions were taken into account throughout the estimate. Quantity take-offs were taken directly from the construction documents. RS Means Costworks 2010 was utilized for all material, labor and equipment costs. Costworks allows several factors to be included in their prices such as; the location to be set to Harrisburg, PA, and time to be set to the 2nd Quarter of 2010. Therefore no additional factors had to be added for time and location. Costwork’s Total Price w/Overhead and Profit was not utilized because it factors an 11% margin for profit and overhead. Instead, 3% was added to Costwork’s Total Unit Price to formulate the Total w/Overhead and Profit to reflect lower profit margins in the industry due to the state of the economy.

Due to the difficult nature of estimating the total amount of reinforcing within CIP concrete elements, a 10% extra/waste factor was utilized to account for items such as overlap at splices, ties, and anchors that are not easily shown on the drawings. The same 10% extra/waste factor was also applied to the formwork take off to account for needed supports during concrete placement. After gathering all the take-off quantities and adding the 10% waste factor, formwork was then divided by 2 ½ to account for re-use of the aluminum form panels. A 3% extra/waste factor was also utilized for the concrete take-off to account for testing and unforeseen conditions. It was assumed that all concrete will be placed via pump except for the pile caps in which will be placed directly from the chute.

It was discovered that RS Means Costworks 2010 did not provide pricing data for every item of the Structural Steel estimate. Therefore pricing for the next closest item was utilized. For example, Costworks’s didn’t provide pricing for 2”-19 Gauge metal floor deck, instead pricing for 2”-18 Gauge was utilized. Similarly wide-flange structural steel members were priced the same way. For example, Costwork’s didn’t provide pricing for a W12x19, so pricing for a W12x22 was utilized. It is believed that the estimated value being 5.8% greater than the actual construction costs is because the “next biggest item” was chosen for items not listed in the Costworks software.



GENERAL CONDITIONS ESTIMATE

* See APPENDIX D for General Conditions Estimate

A summarized version of the General Conditions Estimate for the Support Services Building can be seen below in Table 3. Cost amounts are an approximation based on Alexander’s General Conditions Estimate and values from RS Means Costworks 2010.

GENERAL CONDITIONS SUMMARY				
DESCRIPTION	UNIT	QUANTITY	UNIT RATE	COST
Personnel	Month	15	\$53,797.33	\$806,960.00
Construction Facilities & Equipment	Month	15	\$4,750.00	\$71,250.00
Temporary Utilities/Services	Month	15	\$2,265.00	\$33,975.00
Miscellaneous	Month	15	\$1,083.33	\$16,250.00
Total	Months	15	\$61,895.66	\$928,435.00

Table 3: General Conditions Estimate Summary

As seen in Table 3 above, the General Conditions was broken down into four sections; Personnel, Construction Facilities & Equipment, Temporary Utilities/Services, and Miscellaneous. Included in the **Personnel** section is the entire management staff for the Construction Manager. As shown in figure 11 below, the Personnel section represents 87% of the total General Conditions Estimate. This is above the typical average for construction projects. However items like Site Fence (charged to the HMC Centerview Parking Garage Phase II project), permits, and insurance are not included in the General Conditions, which reflects why the Personnel percentage is above average.

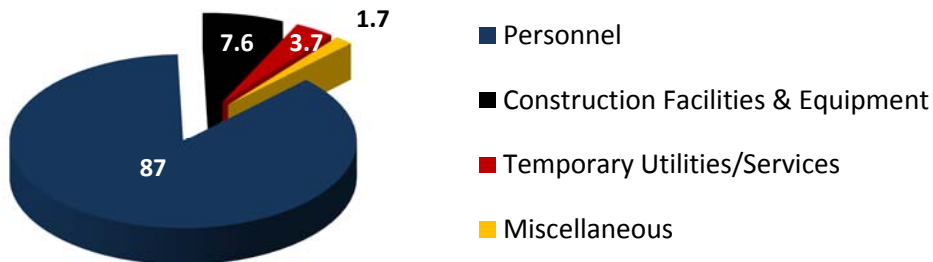


Figure 11: General Conditions Estimate Percent Break-

In the **Construction Facilities & Equipment** section are items such as the field office, dumpsters, expendable small tools, tire wash station, etc. Cost of **Temporary Utilities/Services** is drastically reduced on the Support Services Building Project compared to similar projects because the owner (Penn State Milton S. Hershey Medical Center) is paying for temporary water and power. Included in the Temporary Utilities section is other vital services to the construction team such as telephone service, internet service, use of Submittal Exchange, and field office cleaning. Comprising the final 2% of the estimate is the **Miscellaneous Costs** section which accounts for items like; signage, safety, office supplies, etc.

Overall the General Conditions Estimate is just over 7% (\$21.69 SF) of the total construction cost which is fairly typical for a construction project.



CRITICAL INDUSTRY ISSUES

The 19th Annual PACE Roundtable was held at The Pennsylvania State University on October 27-28, 2010. “Building a Collaborative Culture was the theme of this year’s conference which attracted a large amount of industry leaders and AE students. Along with industry and student discussion panels, there were three main break-out sessions, each divided into two sessions pertaining to following issues:

- **Sustainability / Green Building**
 - Session 1A – Educating a future workforce for delivering high performance buildings
 - Session 2A – The Smart Grid: Energy Impacts in the building industry

- **Technology Applications**
 - Session 1B – Transformation: What are the innovations that will transform our industry
 - Session 2B – Carrying BIM into the field – new responsibilities, roles, and competencies

- **Process Innovation**
 - Session 1C – IPD: Exploring the drivers behind highly integrated delivery of projects
 - Session 2C – Operations & Maintenance process integration in new and retrofit projects

With the new era of construction, Sustainability and Process Innovation are two key areas to focus on; however I decided to attend both sessions on Technology Applications. My goal was to gain a better understanding of what types of technology will become part of the industry in the new future and the how to implement this technology in a field setting.

Technology Applications – Session 1B

In this session the discussion was focused on current and future technologies within the design/construction management industry. Industry experts provided information to students about some of the current technologies their companies are employing to improve their processes. Some of the current technology being utilized included the use of robots to perform field layout from a BIM Model by Truland Systems Corporation, Tablet PCs, and a web-based software program called Latista used by Clark Construction Group on the new Johns Hopkins hospital in Baltimore, Maryland. BIM Models were also discussed and what we could do to provide a more “usable” model to clients. Possible ideas from Chris Magent from Alexander Building Construction Co. included even reducing the size of models in order to a clients staff to navigate the model more efficiently without extensive training.

In the second half of session 1 the discussion shifted towards technology of the future. Both the industry experts and students collaborated and some very unique ideas were tossed around. Some of the ideas were very futuristic, while others are already currently being developed. Dr. John Messner from Penn State discussed how we can adapt computer models using gaming technology into virtual prototyping. The interaction between “real-life” and the models was also discussed and the idea was even tossed around about developing a “Building Simulator” similar to a flight simulator. This would allow a real person to physically maneuver throughout the model and provide greater feedback on the design. It was agreed upon by all that Tablet PC’s are definitely a tool that will help revolutionize the way communication is shared and how Superintendents do their job in the future. Prefabrication was also discussed as a technology that will be utilized more frequently in the future to gain production and quality control.

Technology Applications – Session 2B



In this session the discussion focused on how to take the BIM model & new technologies and incorporate them into the field and the challenges associated with it. Both students and industry experts brainstormed and concluded that possible uses for in the field include; layout, punchlists, product scanning, commissioning, and various other uses. Barton Malow seems to be at the forefront of the industry in this category. They have really taken the Tablet PC and incorporated it into all of their jobsite.

A major part of the discussion involved actual implementation of the ideas mentioned above. All of the industry experts agreed that a major roadblock in implementing newer technology into projects is justifying the added costs to owners. They all also agreed that the demographics of people who know how and embrace the technology is the younger generation, but were quick to point out that a company's needs both types of Superintendents to be successful. Several issues were raised about taking the BIM model into the field. A big limitation that was mentioned was the file size, and how long it takes to download. However I believe that so what if the model takes two or three minutes to download, if it saves you an hour walk back to the trailer. Lastly "futuristic" jobsites were discussed. Possible ideas included; paperless jobsites, wireless jobsites, & large monitors mounted inside gang boxes to view models/drawings in the field.

Getting a Job in a Poor Economy Discussion

Before the conference concluded there was an hour long discussion from industry experts on the current state of the industry and how to get a job. Below are several conclusions from that discussion:

- The industry is still down, and a turnaround could take 2 or 3 more years
- Healthcare & Higher Technology are two markets that seem are seeing the greatest turnaround
- Companies have to work for lower profit margins and be more creative in their approaches
- Companies are still hiring same # of individuals, just their # of offers have decreased
- Students should look take larger interest in field activities

Surprises

- **Amount of input from students** – I though the industry leaders would do more talking in the discussions, however I found they were just as curious to learn as the students were.
- **How technology is currently being utilized** – I was surprised by how much companies are incorporating new technology into their projects.

Ideas for my Thesis

After listening to all of the discussions, there are some items I think I can apply to my project. I would like to see how I can improve the Sustainability/Green aspects of the Support Services Building. The project is scheduled to achieve a LEED Certification rating, but I would like to see the added benefits of incorporating ideas such as more daylighting and photovoltaics into the medal panels would have improved the project. It also interests me on how the subcontractors feel about the electronic document exchange software being utilized on the project.

Contacts

Many of the industry professional's I already knew from prior meetings, however I did meet several new contacts that will help provide me with useful information and insight to my thesis project.



APPENDIX A – Detailed Project Schedule

SUPPORT SERVICES BUILDING

PENN STATE MILTON S. HERSHEY MEDICAL CENTER - HERSHEY PA

WILL LAZRATION

CONSTRUCTION MANAGEMENT

DETAILED PROJECT SCHEDULE

TECHNICAL ASSIGNMENT 2

Activity ID	Activity Name	Original Duration	Start	Finish	2010												2011												2012											
					Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	ep				
PRECONSTRUCTION		102	01-Mar-10	22-Jul-10	22-Jul-10, PRECONSTRUCTION																																			
CM SELECTION/APPROVALS		88	01-Mar-10	01-Jul-10	01-Jul-10, CM SELECTION/APPROVALS																																			
A1980	CM Interviews	5	01-Mar-10	05-Mar-10	■ CM Interviews																																			
A2330	Finalize Building LDP Approvals	40	08-Mar-10	30-Apr-10	■ Finalize Building LDP Approvals																																			
A2340	Finalize Building E&S Approvals (NPDES)	45	08-Mar-10	07-May-10	■ Finalize Building E&S Approvals (NPDES)																																			
A2350	Select CM	0	15-Mar-10		◆ Select CM																																			
A2360	PSU / HMC Board Approval	0	19-Mar-10		◆ PSU / HMC Board Approval																																			
A2370	Campus Drive Re-Alignment E&S Approvals (NPDES)	40	06-May-10	01-Jul-10	■ Campus Drive Re-Alignment E&S Approvals (NPDES)																																			
CD DRAWINGS / GMP / AWARD SUBCONTRACTS		92	15-Mar-10	22-Jul-10	22-Jul-10, CD DRAWINGS / GMP / AWARD SUBCONTRACTS																																			
A2380	Complete Risk Analysis, PM Plan Report	70	15-Mar-10	21-Jun-10	■ Complete Risk Analysis, PM Plan Report																																			
A2390	CM Constructability Review	12	22-Mar-10	06-Apr-10	■ CM Constructability Review																																			
A2400	Bid Package Development	15	29-Mar-10	16-Apr-10	■ Bid Package Development																																			
A2410	Recieve 100% CD's from Architect	0		13-Apr-10	◆ Recieve 100% CD's from Architect																																			
A2420	MBE / WBE Partnership Meeting	1	21-Apr-10	21-Apr-10	MBE / WBE Partnership Meeting																																			
A2430	Site, Structural & MEP Bid Period	15	21-Apr-10	11-May-10	■ Site, Structural & MEP Bid Period																																			
A2431	Selection / Appointment of Material Testing Firm	25	26-Apr-10	28-May-10	■ Selection / Appointment of Material Testing Firm																																			
A2440	Establish Partial GMP	5	12-May-10	18-May-10	■ Establish Partial GMP																																			
A2450	Site, Structural & MEP Scope Review Meetings	15	14-May-10	04-Jun-10	■ Site, Structural & MEP Scope Review Meetings																																			
A2460	PSU / HMC Review & Approval of Partial GMP	6	21-May-10	28-May-10	■ PSU / HMC Review & Approval of Partial GMP																																			
A2470	Award Site, Structural & MEP Subcontracts	10	24-May-10	07-Jun-10	■ Award Site, Structural & MEP Subcontracts																																			
A2480	General Trades & Finishes Bid Period	15	09-Jun-10	29-Jun-10	■ General Trades & Finishes Bid Period																																			
A2490	General Trades & Finishes Scope Review Meetings	10	30-Jun-10	14-Jul-10	■ General Trades & Finishes Scope Review Meetings																																			
A2500	Establish Final GMP	3	15-Jul-10	19-Jul-10	■ Establish Final GMP																																			
A2510	Award General Trades & Finishes Subcontracts	5	15-Jul-10	21-Jul-10	■ Award General Trades & Finishes Subcontracts																																			
A2520	PSU / HMC Review & Approval of Final GMP	3	20-Jul-10	22-Jul-10	■ PSU / HMC Review & Approval of Final GMP																																			
CONSTRUCTION		430	24-May-10	23-Jan-12	23-Jan-12, CONSTRUCTION																																			
PROCUREMENT		279	24-May-10	24-Jun-11	24-Jun-11, PROCUREMENT																																			
A1989	Procure CX Agent	40	24-May-10	20-Jul-10	■ Procure CX Agent																																			
A1990	Structural Steel Shop Drawings	50	07-Jun-10	16-Aug-10	■ Structural Steel Shop Drawings																																			
A2530	Procure / Purchase Electric Transformer (PSU)	90	21-Jul-10	24-Nov-10	■ Procure / Purchase Electric Transformer (PSU)																																			
A2540	AHU's & Electrical Gear Shop Drawings	40	20-Jul-10	14-Sep-10	■ AHU's & Electrical Gear Shop Drawings																																			
A2550	All Remaining Shop Drawings & Submittals	60	28-Jul-10	20-Oct-10	■ All Remaining Shop Drawings & Submittals																																			
A2560	Fabricate and Deliver Structural Steel	30	16-Aug-10	27-Sep-10	■ Fabricate and Deliver Structural Steel																																			
A2570	MEP Coordination Drawings	60	15-Sep-10	09-Dec-10	■ MEP Coordination Drawings																																			
A2580	Fabricate & Deliver AHU's & Electrical Gear	80	15-Sep-10	07-Jan-11	■ Fabricate & Deliver AHU's & Electrical Gear																																			
A2590	Exterior Wall Mock-Up	20	21-Sep-10	18-Oct-10	■ Exterior Wall Mock-Up																																			
A2591	Hardware / Keying Meeting	1	21-Oct-10	21-Oct-10	Hardware / Keying Meeting																																			
A2592	CX Kick-Off Meeting	1	25-Oct-10	25-Oct-10	CX Kick-Off Meeting																																			
A2593	Procurement / Coordination of Building Signage	90	01-Nov-10	09-Mar-11	■ Procurement / Coordination of Building Signage																																			
A2600	Procure FF&E	40	02-May-11	24-Jun-11	■ Procure FF&E																																			
USGBC LEED CERTIFICATION		371	17-Aug-10	23-Jan-12	23-Jan-12, USGBC LEED CERTIFICATION																																			
A1760	USGBC Design Submission	60	17-Aug-10	09-Nov-10	■ USGBC Design Submission																																			
A2610	Recieve USGBC Design Comments	0		10-Nov-10	◆ Recieve USGBC Design Comments																																			
A2620	USGBC Construction Submission	60	31-Oct-11	20-Jan-12	■ USGBC Construction Submission																																			
A2630	Recieve USGBC LEED Certification	0		23-Jan-12	◆ Recieve USGBC LEED Certification																																			
SITework		255	28-May-10	27-May-11	27-May-11, SITework																																			

■ Actual Work ■ Critical Remaining Work ▶ Summary
 ■ Remaining Work ◆ Milestone



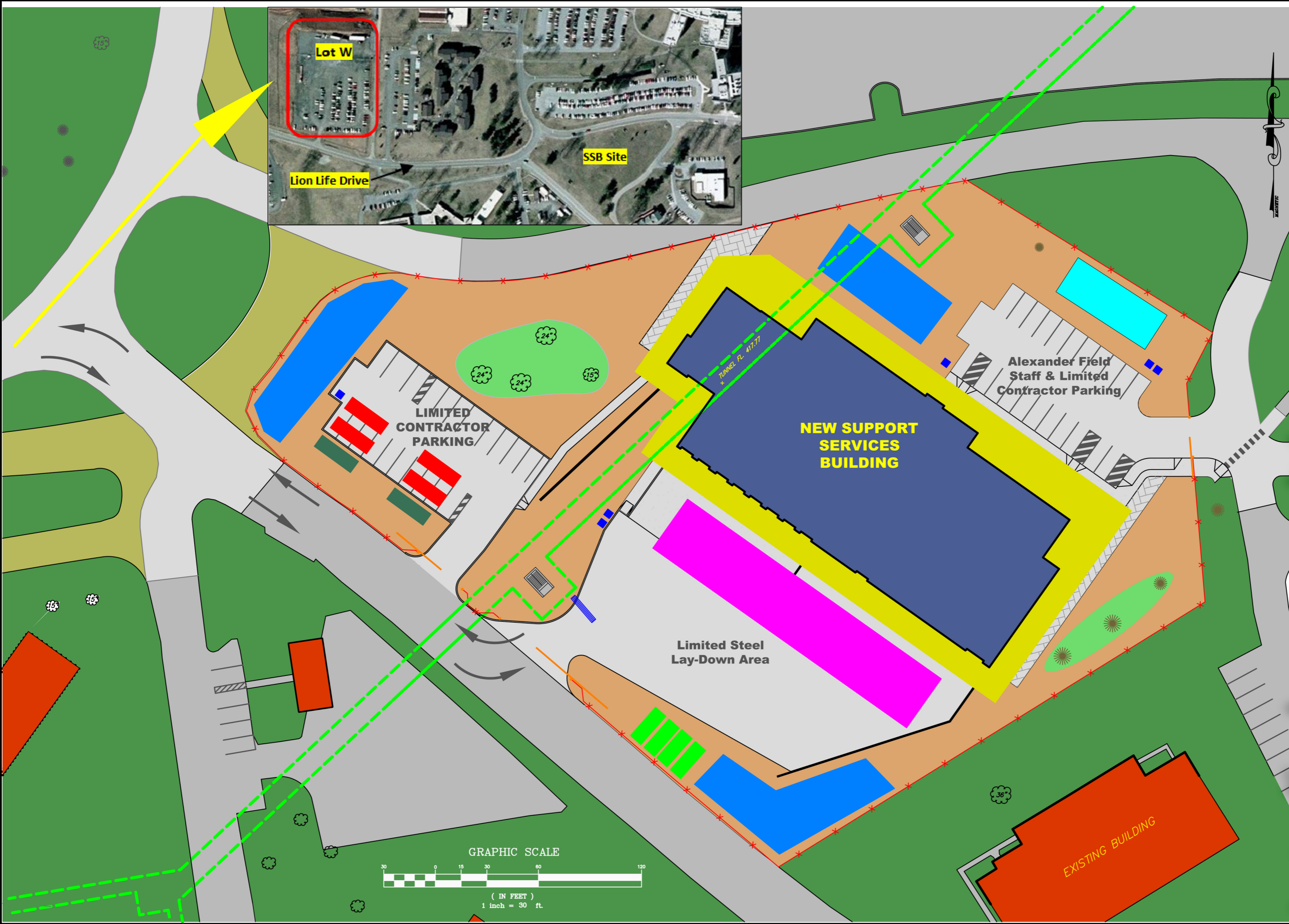
APPENDIX B – Shell & Enclosure Phase Site Layout Plan



LEGEND

SITE FENCE	
CONSTRUCTION GATE	
ALEXANDER FIELD OFFICE	
SUBCONTRACTOR TRAILERS	
STORAGE TRAILERS	
BUILDING FOOTPRINT	
CRANE TRACKING AREA	
MATERIAL LAY-DOWN AREA	
BUILDING ENVELOPE AREA	
DUMPSTERS	
TEMPORARY TOILETS	
OLD CAMPUS DRIVE	
NEW CAMPUS DRIVE	
TREE PROTECTION AREA	
CONSTRUCTION TRAFFIC	
EXISTING BUILDING	
EXISTING UTILITY TUNNEL	
NEW PAVING PER PROJECT	
EXISTING PAVEMENT	
TIRE WASH	

- NOTES:**
- Limited onsite parking and storage available to all contractors. Contractors to utilize Lot W just off Lion Life Drive for additional parking and storage.
 - A limited number of Office and Storage trailers were permitted onsite. Contractor to coordinate with Construction Manager for availability before bringing onsite.
 - Onsite storage/lay-down areas (except for trailers) is limited to one week's work of material unless approval by Construction Manager.
 - Construction access to site is from the west via Bull Frog Road and Lion Life Drive.
 - Per the medical center's request, ABSOLUTELY NO deliveries will be permitted onsite between the hours of 6:30-8:30 A.M. and 3:30-5:30 P.M. However, deliveries to Lot W are permitted during this time.
 - All vehicles onsite must exit through tire wash station prior to returning to main road.



Support Services Building

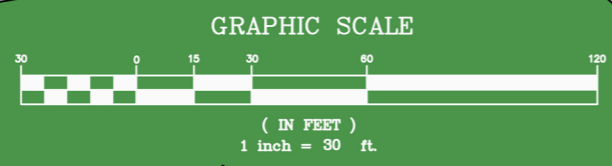
Penn State
Hershey Medical Center
500 University Drive Hershey, PA 17033



SHELL & ENCLOSURE
PHASE PLAN

OCTOBER 25, 2010

WILL LAZRATION
Construction Management





APPENDIX C – Detailed Structural System Estimate



CAST-IN-PLACE CONCRETE TAKE-OFFS

PILE CAPS (4,000 PSI)

ID	Size	Depth	Quantity	Concrete (CY)	Total Concrete (CY)	Reinforcing	Reinforcing Weight (lbs)	Total Reinforcing Weight (ton)
PC1	3'-6" x 3'-6"	45"	1	1.7	1.7	3 #8 & 5 #4	49.26	0.02
PC2	6'-7" x 3'-6"	45"	59	3.2	188.8	6 #8 & 5#4	120.83	3.56
PC2A	6'-7" x 5'-0"	45"	4	4.6	18.4	6 #8 & 5#4	150.85	0.30
PC3	6'-7" x 6'-3"	44"	3	5.6	16.8	3 #9 3-ways	193.80	0.29
PC4	6'-7" x 6'-7"	41"	1	5.5	5.5	22 #11	759.76	0.38
Cont. PC	9'-0" x 43'-0"	45"	1	53.8	53.8	10 #9 & 43 #5	1,865.64	0.93
Subtotal:					285		Subtotal	5.49
3% Waste/Extra :					9		10% Waste/Extra:	0.55
					294		Total	6.04

GRADEBEAMS (4,000 PSI)

ID	Width	Depth	Length	Concrete (CY)	Reinforcing	Total Reinforcing Weight (ton)	Formwork (SFCA)
GB1	2'-10"	2'-6"	5'-0"	1.5	2 #5, 6 #9, 2 #4, 5 #4 ties	0.08	25
GB2	3'-2"	2'-6"	39'-0"	11.5	2 #8, 6 #8 , 2 #4, 39 #4 ties	0.57	195
GB3	2'-10"	2'-6"	27'-0"	7.4	2 #5, 6 #9, 2 #4, 27 #4 ties	0.42	135
GB4	3'-9"	1'-0"	33'-0"	4.6	2 #5, 6 #9, 33 #4 ties	0.48	66
GB5	3'-2"	2'-6"	40'-0"	11.7	2 #5, 6 #9, 2#4, 40 #4 ties	0.63	200
GB6	2'-8"	7'-0"	38'-0"	26.3	2 #5, 6 #9, 12 #4, 38 #4 ties	0.82	532
GB7	2'-0"	4'-0"	25'-0"	7.5	2 #7, 8 #5, 25 #7 ties	0.46	200
GB8	2'-0"	4'-0"	30'-0"	8.9	4 #7, 7 #5, 30 #4 ties	0.32	240
GB9	1'-11"	4'-3"	35'-0"	10.6	6 #4, 12 #9, 35 #4 ties	0.90	298
GB10	1'-4"	9'-0"	21'-0"	9.3	7 #6, 14 #4, 21 #4 ties	0.35	378
GB11	1'-4"	5'-0"	21'-0"	5.2	7 #8, 8 #4, 21 #4 ties	0.34	210
GB12	1'-6"	3'-3"	71'-0"	12.9	7 #8, 8 #4, 71 #4 ties	1.08	462
GB13	1'-4"	5'-4"	12'-0"	3.2	6 #6, 8 #4, 12 #4 ties	0.14	128
GB14	2'-2"	2'-0"	12'-0"	2.1	7 #8, 6 #4, 12 #4 ties	0.18	48
GB15	2'-2"	2'-0"	28'-0"	4.5	7 #8, 6 #4, 12 #4 ties	0.43	112
GB16	1'-4"	7'-0"	47'-0"	16.2	6 #6, 10 #4, 47 #4 ties	0.63	658
GB17	1'-4"	5'-4"	36'-0"	9.5	6 #5, 8 #4, 36 #4 ties	0.37	384
GB18	1'-2"	5'-0"	160'-0"	34.8	7 #7, 6 #4, 160 #4 ties	2.12	1,600
GB19	1'-2"	4'-4"	36'-0"	6.8	6 #5, 4 #4, 36 #4 ties	0.29	312
GB20	1'-4"	5'-0"	50'-0"	12.4	7 #7, 4 #4, 50 #4 ties	0.64	500
GB21	2'-0"	6'-0"	33'-0"	14.8	10 #8, 6 #4, 33 #4 ties	0.68	396
GB22	1'-4"	5'-0"	78'-0"	19.3	7 #7, 6 #4, 78 #4 ties	1.05	780



SUPPORT SERVICES BUILDING
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ID	Width	Depth	Length	Concrete (CY)	Reinforcing	Total Reinforcing Weight (ton)	Formwork (SFCA)
GB23	1'-4"	8'-0"	25'-0"	10	2 #5, 4 #6, 8#4, 25 #4 ties	0.32	400
GB24	1'-4"	5'-0"	25'-0"	6.3	7 #7, 4 #4, 25 #4 ties	0.32	400
GB25	1'-0"	2'-0"	40'-0"	3.1	7 #5, 2 #4, 40 #4 ties	0.25	160
GB26	1'-0"	2'-0"	509'-0"	37.8	6 #7, 2 #4, 509 #4 ties	4.48	2,036
Subtotal:				298	Subtotal:	18.37	10,853
3% Waste/Extra:				9	10% Waste/Extra:	1.84	1,085
Total:				307	Total:	20.20	11,939

FOUNDATION WALLS (4,000 PSI)

ID	Width	Height	Length	Concrete (CY)	Reinforcing	Total Reinforcing Weight (ton)	Formwork (SFCA)
FW1	1'-8"	29'-3"	5'-0"	9.3	50 #5 Horz., 4 #4 VOF, 10 #8 VIF	0.56	293
FW2	1'-4"	15'-3"	39'-0"	29.4	30 #4 Horz., 30 #4 VOF, 39 #6 VIF	0.99	1,190
FW3	1'-8"	29'-3"	27'-0"	48.9	58 #4 Horz., 20 #4 VOF, 54 #8 VIF	2.83	1,580
FW4	2'-8"	35'-3"	38'-0"	132.5	70 #5 Horz., 38 #5 VOF, 57 #9 VIF	5.50	2,679
FW5	1'-4"	13'-5"	25'-0"	16.6	26 #5 Horz., 25 #5 VOF, 25 #6 VIF	0.70	671
FW6	2'-0"	13'-5"	30'-0"	29.9	26 #5 Horz., 30 #4 VOF, 30 #7 VIF	0.95	805
FW7	2'-0"	13'-0"	43'-0"	41.5	26 #5 Horz., 43 #5 VOF, 43 #9 VIF	1.82	1,118
Subtotal:				308	Subtotal:	13.36	8,335
3% Waste/Extra:				9	10% Waste/Extra:	1.34	833
Total:				317	Total:	14.70	9,168

SLABS ON GRADE & STRUCTURAL SLABS (4,000 PSI)

Description	Thickness	Area (SF)	Concrete (CY)	Reinforcing	Total Reinforcing Weight (ton)
Structural SOG (Tunnel Level)	12"	1,090	40.4	#8 at 12" N-S, (2)#5 at 12" E-W	2.60
Structural SOG (Freight Elevator)	12"	260	9.6	#8 at 12" N-S, (2)#5 at 12" E-W	0.51
Mud Slab @ Freight Elevator	2"	260	1.6	-	-
Structural SOG (Passenger Elevator)	12"	72	2.7	#8 at 12" N-S, (2)#5 at 12" E-W	0.15
Mud Slab @ Passenger Elevator	2"	72	0.5	-	-
Structural SOG (Ground Level)	8"	460	11.4	#7 at 12" N-S, #4 at 12" E-W	0.62
Structural SOG (Dock Leveler)	12"	388	14.4	(15) 2 #7, #4 at 12" E-W	0.33
Slab on Grade (Ground Level)	6"	19,460	360.5	#4 at 12" N-S, #4 at 12" E-W	13.89
Thickened Slab (Various Locations GL)	Varies	Varies	123	-	-
Elev Strl Slab (Elevator Machine RMs)	8"	495	12.3	#5 at 12" N-S, (2)#5 at 12" E-W	0.57
Subtotal:			576	Subtotal:	18.7
3% Waste:			17	10% Waste:	1.9
Total:			594	Total:	20.5



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PIERS (4,000 PSI)

ID	Size	Depth	Qty	Concrete (CY)	Total Concrete (CY)	Reinforcing	Reinforcing Weight (lbs)	Total Reinforcing Weight (ton)	Formwork (SFCA)	Total Formwork (SFCA)
P1	27"x27"	3'-0"	4	0.6	2.4	16 #7, 3 #3 ties	108.26	0.22	27	108
P2	20"x27"	4'-0"	6	0.6	3.6	14 #6, 4 #3 ties	95.84	0.29	31	188
P3	23"x18"	4'-0"	1	0.4	0.4	14 #5, 5 #3 ties	71.19	0.04	27	27
P4	23"x18"	7'-0"	2	0.75	1.5	14 #5, 8 #3 ties	78.86	0.08	48	96
P5	23"x18"	7'-5"	1	0.78	0.78	14 #5, 8 #3 ties	128.80	0.06	51	51
P6	23"x23"	7'-5"	1	1	1	16 #6, 7 #3 ties	198.58	0.10	57	57
P7	27"x27"	7'-5"	2	1.4	2.8	16 #7, 7 #3 ties	266.35	0.27	67	134
P8	24"x24"	8'-0"	1	1.2	1.2	16 #6, 8 #3 ties	216.32	0.11	64	64
P9	27"x27"	2'-0"	7	0.38	2.66	16 #7, 2 #3 ties	72.18	0.25	18	126
P10	23"x23"	2'-0"	8	0.27	2.16	16 #6, 2 #3 ties	53.85	0.22	15	123
P11	23"x23"	3'-0"	6	0.41	2.46	16 #6, 3 #3 ties	80.78	0.24	23	138
P12	17"x23"	27'-0"	1	2.71	2.71	14 #5, 32 #3 ties	474.87	0.24	180	180
P13	36"x21"	5'-0"	1	0.97	0.97	18 #6, 5 #3 ties	153.04	0.08	48	48
P14	36"x27"	5'-0"	1	1.25	1.25	20 #7, 4 #3 ties	220.19	0.11	53	53
P15	30"x27"	17'-7"	1	3.67	3.67	18 #5, 22 #3 ties	408.63	0.20	167	167
P16	27"x18"	33'-4"	1	4.2	4.2	14 #6, 33 #3 ties	819.67	0.41	250	250
P17	23"x23"	33'-4"	2	4.53	9.06	16 #6, 33 #3 ties	894.05	0.89	256	511
P18	24"x24"	17'-0"	1	2.52	2.52	16 #6, 17 #3 ties	459.68	0.23	136	136
P19	27"x27"	4'-0"	2	0.75	1.5	17 #7, 4 #3 ties	152.53	0.15	36	72
P20	23"x23"	4'-0"	1	0.54	0.54	16 #6, 4 #3 ties	107.71	0.05	31	31
P21	26"x26"	2'-10"	1	0.49	0.49	16 #6, 3 #3 ties	77.82	0.04	25	25
P22	17"x23"	29'-0"	1	2.92	2.92	14 #5, 35 #3 ties	511.63	0.26	193	193
P23	20"x20"	7'-4"	3	0.75	2.25	12 #6, 7 #3 ties	149.75	0.22	49	147
P24	22"x22"	17'-0"	2	2.12	4.24	12 #6, 17 #3 ties	353.26	0.35	125	249
P25	18"x27"	10'-0"	1	1.25	1.25	14 #6, 10 #3 ties	238.48	0.12	75	75
P26	20"x20"	4'-0"	3	0.41	1.23	12 #6, 4 #3 ties	82.17	0.12	27	80
P27	18"x27"	12'-4"	1	1.54	1.54	14 #6, 12 #3 ties	293.12	0.15	92	92
P28	20"x20"	12'-4"	1	1.27	1.27	12 #6, 12 #3 ties	246.52	0.12	82	82
Subtotal:					63		Subtotal:	5.62		3,501
3% Waste/Extra:					2		10% Waste/Extra:	0.56		350
Total:					65		Total:	6.18		3,851

POLISHED CONCRETE FLOORS

Total SF of Polished Concrete Floor: 20,186



ELEVATED SLABS ON METAL DECK (3,500 PSI)

Description	Thickness	Area (SF)	Concrete (CY)	Reinforcing	Total Reinforcing (CSF)
Slab on Metal Deck (Ground Level)	5.5"	3,600	61.2	6x6 W2.9xW2.9 WWF	36.0
Slab on Metal Deck (2nd Level)	5.5"	16,400	253.1	6x6 W2.9xW2.9 WWF	164.0
Subtotal:			314	Subtotal:	
3% Waste:			9	10% Waste:	
Total:			324	Total:	
				200.0	
				20.0	
				220.0	

STRUCTURAL STEEL TAKE-OFFS

BEAMS & GIRDERS

Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)
W8x10	3'-10"	4	15.32	W14x43	11'-2"	1	11.17	W21x44	12'-7"	1	12.58
W8x10	4'-4"	4	17.32	W14x43	23'-0"	1	23	W21x44	17'-0"	1	17
W8x10	4'-9"	6	28.5	W14x43	34'-2"	1	34.17	W21x44	20'-6"	1	20.5
W8x10	5'-0"	2	10	Total LF of W12x87:			68.34	W21x44	22'-2"	1	22.17
W8x10	5'-6"	1	5.5	W16x26	4'-0"	1	4	W21x44	22'-6"	2	45
W8x10	6'-10"	2	13.66	W16x26	8'-0"	3	24	W21x44	26'-0"	2	52
W8x10	8'-0"	5	40	W16x26	11'-2"	2	22.34	W21x44	33'-2"	2	66.34
W8x10	11'-0"	2	22	W16x26	12'-7"	1	12.58	W21x44	34'-0"	8	272
Total LF of W8x10:			152.3	W16x26	13'-0"	1	13	W21x44	35'-4"	1	35.33
W8x13	5'-0"	2	10	W16x26	14'-4"	1	14.33	W21x44	36'-1"	2	72.16
W8x13	7'-6"	1	7.5	W16x26	17'-3"	2	34.5	W21x44	37'-6"	2	75
W8x13	9'-0"	2	18	W16x26	18'-0"	1	18	Total LF of W21x44:			690.08
W8x13	12'-0"	2	24	W16x26	18'-4"	1	18.33	W21x50	3'-10"	1	3.83
Total LF of W8x13:			59.5	W16x26	21'-6"	1	21.5	W21x50	12'-7"	1	12.58
W8x15	9'-4"	4	37.32	W16x26	22'-6"	5	112.5	W21x50	13'-0"	2	26
W8x15	10'-10"	5	54.15	W16x26	23'-0"	4	92	W21x50	16'-6"	1	16.5
W8x15	20'-2"	1	20.17	W16x26	23'-10"	1	23.83	W21x50	29'-3"	1	29.25
Total LF of W8x15:			111.64	W16x26	24'-5"	3	73.26	W21x50	34'-0"	1	34
W8x24	4'-6"	1	4.5	W16x26	29'-3"	1	29.25	W21x50	37'-6"	3	112.5
Total LF of W8x24:			4.5	W16x26	31'-5"	2	62.84	Total LF of W21x50:			234.66
W10x12	4'-0"	2	8	W16x26	11'-0"	1	11	W24x55	18'-4"	1	18.33
W10x12	10'-4"	1	10.33	Total LF of W16x26:			587.26	W24x55	21'-6"	1	21.5
W10x12	8'-0"	1	8	W16x31	12'-7"	2	25.16	w24x55	24'-5"	1	24.42
W10x12	11'-7"	6	69.48	W16x31	17'-0"	5	85	W24x55	29'-3"	1	29.33
W10x12	13'-0"	6	78	W16x31	17'-8"	1	17.67	W24x55	31'-5"	1	35.42
Total LF of W10x12:			173.81	W16x31	18'-4"	1	18.33	W24x55	33'-2"	1	33.17
W10x19	11'-6"	3	34.5	W16x31	22'-6"	2	45	W24x55	34'-0"	1	34
Total LF of W10x19:			34.5	W16x31	23'-0"	2	46	W24x55	34'-6"	1	34.5
W12x14	4'-0"	4	16	W16x31	24'-5"	3	73.26	W24x55	36'-1'	4	144.32
W12x14	7'-0"	4	28	W16x31	26'-0"	3	78	W24x55	37'-6"	7	262.5



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W12x14	9'-0"	3	27
W12x14	10'-4"	2	20.66
W12x14	11'-7"	16	185.28
W12x14	13'-0"	3	39
W12x14	14'-4"	1	14.33
W12x14	14'-10"	10	148.3
W12x14	16'-6"	2	33
W12x14	17'-3"	15	258.75
W12x14	18'-0"	5	90
W12x14	22'-6"	1	22.5
Total LF of W12x14:			882.82
W12x19	7'-3"	5	36.25
W12x19	17'-0"	3	51
W12x19	18'-0"	2	36
W12x19	22'-6"	1	22.5
Total LF of W12x19:			145.75
W12x26	5'-4"	5	27
W12x26	11'-7"	1	11.58
W12x26	12'-2"	2	24.34
Total LF of W12x26:			63
W12x35	7'-10"	3	23.49
W12x35	8'-10"	1	8.83
W12x35	12'-2"	1	12.17
Total LF of W12x35:			44.49
W12x53	14'-3"	2	28.5
W12x53	16'-6"	1	16.5
Total LF of W12x53:			45
W12x87	16'-6"	1	16.5
Total LF of W12x87:			16.5
W14x22	11'-2"	2	22.34
W14x22	11'-7"	2	23.16
W14x22	14'-4"	1	14.33
W14x22	16'-0"	2	32
W14x22	17'-1"	1	17.08
W14x22	18'-0"	4	72
W14x22	20'-6"	1	20.5
W14x22	21'-6"	2	43
W14x22	22'-6"	2	45
W14x22	23'-0"	13	299
W14x22	24'-4"	1	24.33
W14x22	25'-6"	3	76.5
Total LF of W14x22:			689.24

W16x31	31'-5"	1	31.42
W16x31	34'-2"	1	34.17
Total LF of W16x31:			454.0
W18x35	8'-10"	1	8.8
W18x35	11'-6"	1	11.50
W18x35	14'-4"	2	28.66
W18x35	15'-0"	1	15.0
W18x35	18'-0"	1	18.0
W18x35	21'-6"	1	21.50
W18x35	22'-6"	4	90.00
W18x35	23'-0"	3	69.00
W18x35	23'-10"	3	71.49
W18x35	24'-5"	3	73.26
W18x35	29'-3"	1	29.25
W18x35	33'-2"	7	232.19
W18x35	34'-2"	13	444.21
W18x35	34'-10"	1	34.83
W18x35	35'-4"	2	70.66
W18x35	37'-6"	1	37.5
Total LF of W18x35:			1,255.88
W18x40	4'-2"	1	4.17
W18x40	22'-6"	2	45
W18x40	23'-10"	1	23.83
W18x40	24'-5"	1	24.42
W18x40	25'-6"	1	25.5
W18x40	26'-0"	2	52
W18x40	33'-2"	4	132.68
Total LF of W18x40:			307.60
W18x55	22'-6"	1	22.5
W18x55	24'-5"	1	24.42
W18x55	34'-2"	2	68.34
Total LF of W18x55:			115.26

Total LF of W24x55:			637.49
W24x68	31'-5"	1	31.42
W24x55	34'-2"	2	68.34
W24x68	34'-6"	1	34.5
Total LF of W24x68:			134.26
W30x99	29'-3"	1	29.25
Total LF of W30x99:			29.25
W30x132	36'-1"	1	36.08
Total LF of W30x132:			36.08
HSS 6x2x 1/4"	14'-0"	1	14
HSS 6x2x 1/4"	27'-2"	1	27.17
Total LF of HSS 6x2x 1/4":			41.17
HSS 6x4x 1/4"	3'-8"	10	36.7
Total LF of HSS 6x4x 1/4":			36.7
HSS 8x4x 1/4"	8'-2"	4	32.68
HSS 8x4x 1/4"	8'-10"	2	17.66
HSS 8x4x 1/4"	10'-4"	8	82.64
HSS 8x4x 1/4"	13'-0"	2	26
HSS 8x4x 1/4"	13'-10"	2	27.66
Total LF of HSS 8x4x 1/4":			186.64
HSS 8x8x 3/8"	15'-6"	1	15.5
Total LF of HSS 8x8x 3/8":			15.5
HSS 12x4x 1/4"	11'-2"	4	44.68
Total LF of HSS 12x4x 1/4":			44.68
HSS 12x6x 1/4"	18'-4"	5	91.65
HSS 12x6x 1/4"	22'-0"	1	22
Total LF of HSS 12x6x 1/4":			113.65
HSS 18x8x 5/16"	18'-4"	2	36.66
HSS 18x8x 5/16"	22'-0"	2	44
Total LF of HSS 18x8x 5/16":			80.66



COLUMNS											
Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)
W10x33	16'-7"	2	33.16	W10x68	13'-0"	1	13	W12x120	16'-7"	2	33.16
W10x33	16'-11"	1	16.92	W10x68	22'-11"	1	22.92	W12x120	16'-11"	1	16.92
W10x33	22'-11"	2	45.84	Total LF of W10x68:			35.92	W12x120	28'-11"	3	86.76
W10x33	26'-4"	2	26.34	W12x79	13'-0"	1	13	W12x120	29'-11"	1	29.92
W10x33	28'-11"	5	144.60	W12x79	49'-3"	1	49.25	W12x120	33'-7"	1	33.58
W10x33	33'-7"	1	33.58	Total LF of W12x79:			62.25	W12x120	33'-11"	12	407.04
W10x33	33'-11"	9	305.28	HSS 6x6x 1/4"	33'-7"	3	100.74	W12x120	34'-11"	1	34.92
Total LF of W10x33:			605.718	HSS 6x6x 1/4"	33'-11"	3	101.76	W12x120	35'-11"	4	143.68
W10x39	28'-11"	1	28.92	Total LF of HSS 6x6x 1/4":			202.5	W12x120	49'-3"	1	49.25
W10x39	33'-11"	1	33.92	HSS 8x8x 5/16"	47'-11"	2	95.84	W12x120	75'-0"	1	75
Total LF of W10x39:			62.84	Total LF of HSS 8x8x 5/16":			95.84	Total LF of W12x120:			910.23
W10x49	16'-7"	1	16.58								
W10x49	16'-11"	1	16.92								
W10x49	32'-11"	1	32.92								
Total LF of W10x49:			66.42								

ROOF JOISTS											
Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)	Size	Length (FT)	Qty	Total Length (LF)
10K1	10'-11"	2	21.84	14KCS3	17'-0"	4	68	24K5	32'-4"	13	444.21
10K1	12'-7"	6	75.48	Total LF of 14KCS3:			68	Total LF of 24K5:			444.21
Total LF of 10K1:			97.32	16K2	21'-6"	6	129	24K6	34'-0"	11	374
12K1	18'-4"	5	91.65	Total LF of 16K2:			129	24K6	34'-2"	5	170.85
Total LF of 12K1:			91.65	16K3	23'-0"	14	322	Total LF of 26K6:			544.85
14K1	20'-6"	13	266.5	Total LF of 16K3:			322	26K7	37'-6"	14	525
Total LF of 14K1:			266.5	18KCS2	20'-6"	14	287	Total LF of 26K7:			525
14KCS2	17'-0"	9	153	Total LF of 18KCS2:			287				
Total LF of 14KCS2:			153								

MISCELLANEOUS							
Item	Unit	QTY	Total	Size	Length (FT)	Qty	Total Length (LF)
2"-19 Gauge Metal Floor Deck (1st Floor)	SF	3,600	3,600	L 3x3	5'-6"	1	5.5
2"-19 Gauge Metal Floor Deck (2nd Floor)	SF	16,400	16,400	L 3x3	7'-2"	1	7.17
Total SF of 2"-19 Gauge Metal Floor Deck:			20,000	L3x3	17'-0"	4	68
1 1/2"-22 Gauge Metal Roof Deck (Low Roof)	SF	3,800	3,800	L3x3	24'-5"	1	24.42
1 1/2"-22 Gauge Metal Roof Deck (Main Roof)	SF	20,600	20,600	L3x3	34'-2"	1	34.17



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Item	Unit	QTY	Total
1 1/2"-22 Gauge Metal Roof Deck (High Roof)	SF	930	930
Total SF of 1 1/2"-22 Gauge Metal Roof Deck:			25,330
4 1/2" x 3/4" Shear Studs (1st Floor)	Each	295	295
4 1/2" x 3/4" Shear Studs (2nd Floor)	Each	1,783	1,783
Total #of 4 1/2" x 3/4" Shear Studs:			2,078

Size	Length (FT)	Qty	Total Length (LF)
L3x3	36'-1"	1	36.08
Total LF of L3x3:			175.34

CAST-IN-PLACE CONCRETE ESTIMATE PRICING

Description	Unit	QTY	Bare Material	Bare Labor	Bare Equipment	Bare Total	Total Inc. O & P	Total Cost
REINFORCING								
Pile Caps	Ton	6.04	\$784.32	\$753.61	-	\$1,537.93	\$1,614.83	\$9,759.43
Grade Beams	Ton	20.20	\$784.32	\$985.49	-	\$1,811.09	\$1,901.64	\$38,418.54
Foundation Walls	Ton	20.20	\$784.32	\$985.49	-	\$1,811.09	\$1,901.64	\$38,418.54
SOG & Structural Slabs	Ton	20.53	\$784.32	\$685.10	-	\$1,469.42	\$1,542.89	\$31,679.14
Elevated Slabs	CSF	220	\$24.77	\$27.40	-	\$52.17	\$54.78	\$12,051.27
Piers	Ton	6.18	\$784.32	\$753.61	-	\$1,537.93	\$1,614.83	\$9,983.74
TOTAL:								\$140,310.65
CONCRETE								
Pile Caps (4,000 PSI)	CY	294	\$101.15	\$9.16	\$0.41	\$101.14	\$115.78	\$33,987.22
Grade Beams (4,000 PSI)	CY	307	\$101.15	\$12.21	\$5.15	\$108.93	\$123.96	\$38,073.82
Foundation Walls (4,000 PSI)	CY	317	\$101.15	\$14.63	\$6.21	\$112.41	\$127.61	\$40,496.14
SOG & Structural Slabs (4,000 PSI)	CY	594	\$101.15	\$14.58	\$0.64	\$106.79	\$121.71	\$72,258.25
Elevated Slabs (3,500 PSI)	CY	324	\$98.04	\$15.70	\$6.61	\$110.77	\$125.89	\$40,754.24
Piers (4,000 PSI)	CY	65	\$101.15	\$14.63	\$6.21	\$112.41	\$127.61	\$8,294.65
TOTAL:								\$233,864.32
FORMWORK								
Grade Beams	SFCA	4,776	\$22.66	\$5.91	-	\$28.57	\$30.00	\$143,258.24
Foundation Walls	SFCA	3,667	\$22.66	\$6.18	-	\$28.84	\$30.28	\$111,052.21
Piers	SFCA	1,540	\$22.66	\$5.91	-	\$28.57	\$30.00	\$46,210.85
TOTAL:								\$300,521.30
Polished Concrete Floors								
Finishing	SF	20,186	-	\$0.22	\$0.07	\$0.29	\$0.40	\$8,074.40
TOTAL CONCRETE ESTIMATE:								\$682,770.68



STRUCTURAL STEEL ESTIMATE PRICING

Description	Unit	QTY	Bare Material	Bare Labor	Bare Equipment	Bare Total	Total Inc. O & P	Total Cost
BEAMS								
W8x10	LF	152.3	\$11.13	\$5.15	\$3.11	\$19.39	\$19.97	\$3,041.69
W8x13	LF	59.5	\$16.70	\$5.15	\$3.11	\$24.96	\$25.71	\$1,529.67
W8x15	LF	111.64	\$16.70	\$5.15	\$3.11	\$24.96	\$25.71	\$2,870.13
W8x24	LF	4.5	\$26.68	\$5.61	\$3.39	\$35.68	\$36.75	\$165.38
W10x12	LF	173.81	\$13.34	\$5.15	\$3.11	\$21.60	\$22.25	\$3,866.92
W10x19	LF	34.5	\$24.38	\$5.15	\$3.11	\$32.64	\$33.62	\$1,159.86
W12x14	LF	882.82	\$17.80	\$3.51	\$2.12	\$23.43	\$24.13	\$21,305.01
W12x19	LF	145.75	\$24.38	\$3.51	\$2.12	\$30.01	\$30.91	\$4,505.18
W12x26	LF	63	\$28.98	\$3.51	\$2.12	\$34.61	\$35.65	\$2,230.51
W12x35	LF	44.49	\$39.10	\$3.81	\$2.30	\$45.21	\$46.57	\$2,071.73
W12x53	LF	45	\$64.40	\$4.12	\$2.48	\$71.00	\$73.13	\$3,290.85
W12x87	LF	16.5	\$96.60	\$4.82	\$2.91	\$104.33	\$107.46	\$1,773.09
W14x22	LF	689.24	\$28.98	\$3.12	\$1.88	\$33.98	\$35.00	\$24,122.99
W14x43	LF	68.34	\$47.84	\$3.81	\$2.30	\$53.95	\$55.57	\$3,797.55
W16x26	LF	587.26	\$28.98	\$3.08	\$1.87	\$33.93	\$34.95	\$20,523.50
W16x31	LF	454.01	\$34.50	\$3.43	\$2.08	\$40.01	\$41.21	\$18,709.89
W18x35	LF	1,255.88	\$39.10	\$4.65	\$2.12	\$45.87	\$47.25	\$59,335.43
W18x40	LF	307.60	\$44.62	\$4.65	\$2.12	\$51.39	\$52.93	\$16,281.79
W18x55	LF	115.26	\$61.18	\$4.90	\$2.23	\$68.31	\$70.36	\$8,109.61
W21x44	LF	690.08	\$48.76	\$4.20	\$1.91	\$54.87	\$56.52	\$39,000.63
W21x50	LF	234.66	\$55.66	\$4.20	\$1.91	\$61.77	\$63.62	\$14,929.80
W24x55	LF	637.49	\$61.18	\$4.03	\$1.83	\$67.04	\$69.05	\$44,019.45
W24x68	LF	134.26	\$75.90	\$4.03	\$1.83	\$81.76	\$84.21	\$11,306.41
W30x99	LF	29.25	\$110.40	\$3.72	\$1.69	\$151.81	\$156.36	\$4,573.66
W30x132	LF	36.08	\$147.20	\$3.86	\$1.75	\$152.81	\$157.39	\$5,678.79
HSS 6x2x 1/4"	# 12 Ft Sect.	3	\$253.00	\$57.43	\$34.80	\$345.23	\$355.59	\$1,219.96
HSS 6x4x 1/4"	# 12 Ft Sect.	3	\$253.00	\$57.43	\$34.80	\$345.23	\$355.59	\$1,087.50
HSS 8x4x 1/4"	# 12 Ft Sect.	3	\$368.00	\$57.43	\$34.80	\$460.23	\$474.04	\$1,449.76
HSS 8x8x 3/8"	# 12 Ft Sect.	3	\$368.00	\$57.43	\$34.80	\$460.23	\$474.04	\$1,290.96
HSS 12x4x 1/4"	# 12 Ft Sect.	1	\$1,104.00	\$68.04	\$38.66	\$1,206.94	\$1,243.15	\$1,829.50
HSS 12x6x 1/4"	# 12 Ft Sect.	7	\$1,104.00	\$68.04	\$38.66	\$1,206.94	\$1,243.15	\$8,561.15
HSS 18x8x 5/16"	# 12 Ft Sect.	2	\$1,104.00	\$68.04	\$38.66	\$1,206.94	\$1,243.15	\$2,693.49
TOTAL:								\$336,331.84
COLUMNS								
W10x33	LF	605.72	\$50.14	\$2.99	\$1.81	\$54.94	\$56.59	\$34,276.49
W10x39	LF	62.84	\$50.14	\$2.99	\$1.81	\$54.94	\$56.59	\$3,556.00
W10x49	LF	66.42	\$75.90	\$3.14	\$1.89	\$80.93	\$83.36	\$5,536.63
W10x68	LF	35.92	\$75.90	\$3.14	\$1.89	\$80.93	\$83.36	\$2,994.22



SUPPORT SERVICES BUILDING
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Description	Unit	QTY	Bare Material	Bare Labor	Bare Equipment	Bare Total	Total Inc. O & P	Total Cost
W12x79	LF	62.25	\$96.60	\$3.14	\$1.89	\$101.63	\$104.68	\$6,516.26
W12x120	LF	910.23	\$133.40	\$3.22	\$1.94	\$138.56	\$142.72	\$129,905.11
HSS 6x6x 1/4"	# 12 Ft Sect.	17	\$253.00	\$57.43	\$34.80	\$345.23	\$355.59	\$6,000.53
HSS 8x8x 5/16"	# 12 Ft Sect.	8	\$368.00	\$57.43	\$34.80	\$460.23	\$474.04	\$3,785.97
TOTAL:								\$192,571.22
ROOF JOISTS								
10K1	LF	97.32	\$2.72	\$3.81	\$1.83	\$8.36	\$8.61	\$838.00
12K1	LF	91.65	\$3.11	\$3.04	\$1.47	\$7.62	\$7.85	\$719.32
14K1	LF	266.5	\$3.27	\$3.04	\$1.47	\$7.78	\$8.01	\$2,135.57
14KCS2	LF	153	\$3.27	\$3.04	\$1.47	\$7.78	\$8.01	\$1,226.05
14KCS3	LF	68	\$3.27	\$3.04	\$1.47	\$7.78	\$8.01	\$544.91
16K2	LF	129	\$3.43	\$2.54	\$1.22	\$7.19	\$7.41	\$955.34
16K3	LF	322	\$3.43	\$2.54	\$1.22	\$7.19	\$7.41	\$2,384.64
18KCS2	LF	287	\$4.20	\$2.29	\$1.10	\$7.59	\$7.82	\$2,243.68
24K5	LF	444.21	\$5.18	\$2.08	\$1.00	\$8.26	\$8.51	\$3,779.25
24K6	LF	544.85	\$5.18	\$2.08	\$1.00	\$8.26	\$8.51	\$4,635.47
26K7	LF	525	\$5.66	\$2.08	\$1.00	\$8.74	\$9.00	\$4,726.16
TOTAL:								\$24,188.39
MISCELLANEOUS								
2"-19 Gauge Metal Floor Deck	SF	20,000	\$1.80	\$0.56	\$0.05	\$2.41	\$2.85	\$57,000.00
1 1/2"-22 Gauge Metal Roof Deck	SF	25,330	\$1.16	\$0.43	\$0.03	\$1.62	\$2.05	\$51,926.50
4 1/2" x 3/4" Shear Studs	EA	2,078	\$1.86	\$0.41	\$0.05	\$2.31	\$2.75	\$5,714.50
L3x3	LF	175.34	\$4.37	\$24.18	\$2.97	\$31.52	\$32.47	\$5,692.52
Base Plates/Connections							15% of Total	\$82,963.73
TOTAL:								\$203,297.24
TOTAL STRUCTURAL STEEL ESTIMATE:								\$756,388.69



APPENDIX D – General Conditions Estimate



SUPPORT SERVICES BUILDING
Penn State Milton S. Hershey Medical Center – Hershey PA

November 4, 2010

PERSONNEL				
DESCRIPTION	WEEKS ON PROJECT	HOURS/WEEK	UNIT RATE	COST
Senior Project Manager	65	16	\$100.00	\$104,000.00
Project Manager	65	25	\$88.00	\$143,000.00
Superintendent	65	40	\$93.00	\$241,800.00
MEP Coordinator	40	8	\$75.00	\$24,000.00
Project Engineer	60	40	\$61.00	\$146,400.00
Project Assistant	65	40	\$30.00	\$78,000.00
Intern	15	40	\$20.00	\$12,000.00
Corporate Safety Director	40	4	\$86.00	\$13,760.00
Carpenter Foreman	20	40	\$55.00	\$44,000.00
Total Manhours:		12,145	Total Staff Costs:	\$806,960.00

CONSTRUCTION FACILITIES & EQUIPMENT				
DESCRIPTION	UNIT	QUANTITY	UNIT RATE	COST
Field Office Setup	LS	1	\$2,000.00	\$2,000.00
Field Office Rental	Month	15	\$600.00	\$9,000.00
Field Office Removal	LS	1	\$2,000.00	\$2,000.00
Field Office Furniture & Equipment	Month	15	\$450.00	\$6,750.00
Field Office Telephone Install	LS	1	\$750.00	\$750.00
Field Office Internet Connection Installation	LS	1	\$1,500.00	\$1,500.00
Temporary Power/Water Installation	LS	1	\$10,000.00	\$10,000.00
Dumpsters	Each	25	\$600.00	\$15,000.00
Fire Extinguishers	Month	15	\$100.00	\$1,500.00
Expendable Small Tools	Month	15	\$250.00	\$3,750.00
Tire Wash Station	Month	10	\$1,900.00	\$19,000.00
Total Construction Facilities & Equipment Costs				\$71,250.00

TEMPORARY UTILITIES /SERVICES				
DESCRIPTION	UNIT	QUANTITY	UNIT RATE	COST
Temporary Toilets	Month	15	\$400.00	\$6,000.00
Field Office Cleaning	Week	65	\$200.00	\$13,000.00
Field Office Telephone Usage	Month	15	\$200.00	\$3,000.00
Field Office Internet Usage	Month	15	\$90.00	\$1,350.00
Mobile Phones	Month	15	\$175.00	\$2,625.00
Submittal Exchange	LS	1	\$5,500.00	\$5,500.00
Professional Surveying	LS	1	\$4,500.00	\$4,500.00
Temporary Power/Water Usage	By Owner			\$0.00
Total Temporary Utilities/Services Costs				\$35,975.00



MISCELLANEOUS COSTS				
DESCRIPTION	UNIT	QUANTITY	UNIT RATE	COST
Travel/Mileage	Mile	5,000	\$0.45	\$2,250.00
Job Signage	LS	1	\$1,500.00	\$1,500.00
Office Supplies	Month	15	\$200.00	\$3,000.00
Document Printing	Month	15	\$150.00	\$2,250.00
Postage & Courier Service	Month	15	\$250.00	\$3,750.00
Safety	LS	1	\$2,000.00	\$2,000.00
Incidentals	LS	1	\$1,500.00	\$1,500.00
Total Miscellaneous Costs				\$16,250.00

GENERAL CONDITIONS SUMMARY				
DESCRIPTION	UNIT	QUANTITY	UNIT RATE	COST
Personnel	Month	15	\$53,797.33	\$806,960.00
Construction Facilities & Equipment	Month	15	\$4,750.00	\$71,250.00
Temporary Utilities/Services	Month	15	\$2,265.00	\$33,975.00
Miscellaneous	Month	15	\$1,083.33	\$16,250.00
Total	Months	15	\$61,895.66	\$928,435.00