September 29, 2010

TECHNICAL ASSIGNMENT ONE

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

In March 2010 The Penn State Board of Trustees approved the plans and released the Support Services Building Project at the Penn State Milton S. Hershey Medical Center for construction. The new building will relocate the main shipping/receiving dock as well as many of the medical center's support services from its current location underneath the existing hospital to their own separate building in order to keep up with the demands of the demands of the growing medical center. The project is also intended to achieve a LEED Certified rating upon completion. After interviewing several CM firms, Alexander Building Construction Co. from Harrisburg, PA was chosen as the CM at Risk under the traditional Design-Bid-Build delivery method with a GMP just over $14.3 million.

Construction of the Support Services Building began on June 1st 2010 and final completion is scheduled for September 30th 2011. Detailed information regarding the projects schedule can be found in the Project Summary Schedule section. The triangular shaped site on the southwestern part of campus provides many challenges to the construction team. Traversing the site is a utility tunnel that houses the main steam and chilled water lines for the hospital. Careful planning and constant monitoring is being utilized to maintain the integrity of the tunnel. The re-alignment of Campus Drive also provided logistical issues for the construction team in the early stages of the project. More details about the existing site conditions can be found in the Existing Conditions Site Plan summary section.

To achieve the modern look the University/Medical Center is looking for, the new building will be clad in a combination of metal panels, stone veneer, and glass curtain wall. Supporting the building is a rigid steel superstructure set on micropiles and gradebeams. A more detailed look into the building systems can be found in the Building Systems Summary section. Given the parameters of the project, D4COST comparisons and RSMEANS Square Foot estimates were produced for price comparison purposes. Detailed comparisons are located in the Project Cost Evaluation section.

To better understand the environment surrounding the project an in-depth look of the local conditions at the medical center and the university's expectations for the project can be found in the Local Conditions and Client Information sections. Alexander's plan to meet the university's expectations starts with their experienced construction team and supporting personnel in their corporate office. As requested by the university Alexander and several key subcontractors were required to submit Performance and Payment Bonds. Subcontractors were selected after the standard bid period and holding scope review meeting with the three lowest bidders. More detailed information on the relationships between the design team, Alexander, and subcontractors can be found in the Project Organization System and Staffing Plan sections.

PROJECT SUMMARY SCHEDULE

*** See APPENDIX A for Project Summary Schedule**

Over the past several years Penn State Milton S. Hershey Medical Center conventionally used the same architect (Payette Associates) on all of their projects. For the Support Services Building project they decided to go elsewhere and enlist the services of Highland Associates. On March 19th 2010 the University Board of Trustees approved the initial plans for the project. Shortly afterwards Alexander Building Construction Co. from Harrisburg, PA was selected as the CM for the project. Alexander was brought on roughly a month before final construction documents were released for construction in order to provide constructability reviews and value engineering services.

Two months of preconstruction services (developing bid packages, bidding, holding scope reviews, & awarding contracts) occurred during the months of April and May 2010. Actual construction began the first week of June 2010. Construction of the project was broken down into 4 distinct phases Sitework; Shell & Enclosure, Interior Fit-out, and Closeout. Sitework was further broken down into Building Sitework and Campus Drive realignment. The Interior fit-out was also broken down into 1st and 2nd floors respectively.

Sitework began on June 7th 2010 with the installation of E&S control measures. After the E&S control measures were in place, site clearing and site utilities commenced and continued throughout the entire month of June. Construction of the Campus Drive Realignment phase began the last week of June and was schedule to be completed at the end of September. As a part of the initial sitework, all new parking lots were cut to sub-grade and 6" of compacted stone was installed. The binder course of asphalt paving is scheduled to be installed prior to steel erection to help minimize muddy conditions on the site.

Micropile installation began on the 1st of July and was followed by cast-in place concrete foundations components. Completion of the pile caps, grade beams, and foundation walls is currently scheduled for the 10th of October 2010. Due to the number of interior masonry walls and load bearing masonry walls the SOG will be poured prior to steel erection. Steel erection is scheduled to begin at the end of October and be completed by Thanksgiving. After steel erection is complete, exterior masonry walls on the east and south sides of the building will be constructed. Currently the roof is scheduled for completion in mid December 2010. Once the New Year begins, exterior metal stud walls will commence, starting with the east side and following the order; east-north-south-west with scheduled completion of exterior finishes in mid June 2011.

Also starting right after the New Year is the construction of the interior fit-out starting with the 2nd level. Construction of the interior fit-out of the 1st level is currently scheduled to start three weeks after the start of the 2nd floor. Currently the interior fit-out for both levels is scheduled to be completed by the end of July 2011. Alexander also plans for all close-out documents to be submitted 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 the month of September has been scheduled for commissioning, owner training, and movement of the owner's equipment/furniture into the building with a final completion date of September 30, 2011. After final completion the current schedule shows the building receiving its LEED Certification by the end of January 2012.

BUILDING SYSTEMS SUMMARY

BUILDING SYSTEMS CHECKLIST		
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

Table 1: Building Systems Checklist

DEMOLITION:

Being that the site that was chosen for the location of the Support Services Building was a barren field minimal demolition was required. However there were approximately 25 evergreen trees, 400LF of an 18" corrugated metal storm drainage pipe, and 45,000SF of asphalt paving that was removed in order to construct the Support Services Building and Campus Drive realignment (See figure 1 below). Of the 45,000SF of asphalt that was removed, approximately 15,000SF came from the removal of a 480LF section of Long Lane (southern part of site) to make room for the building. The remaining 30,00SF of asphalt paving was removed as a part of the realignment of Campus Drive.

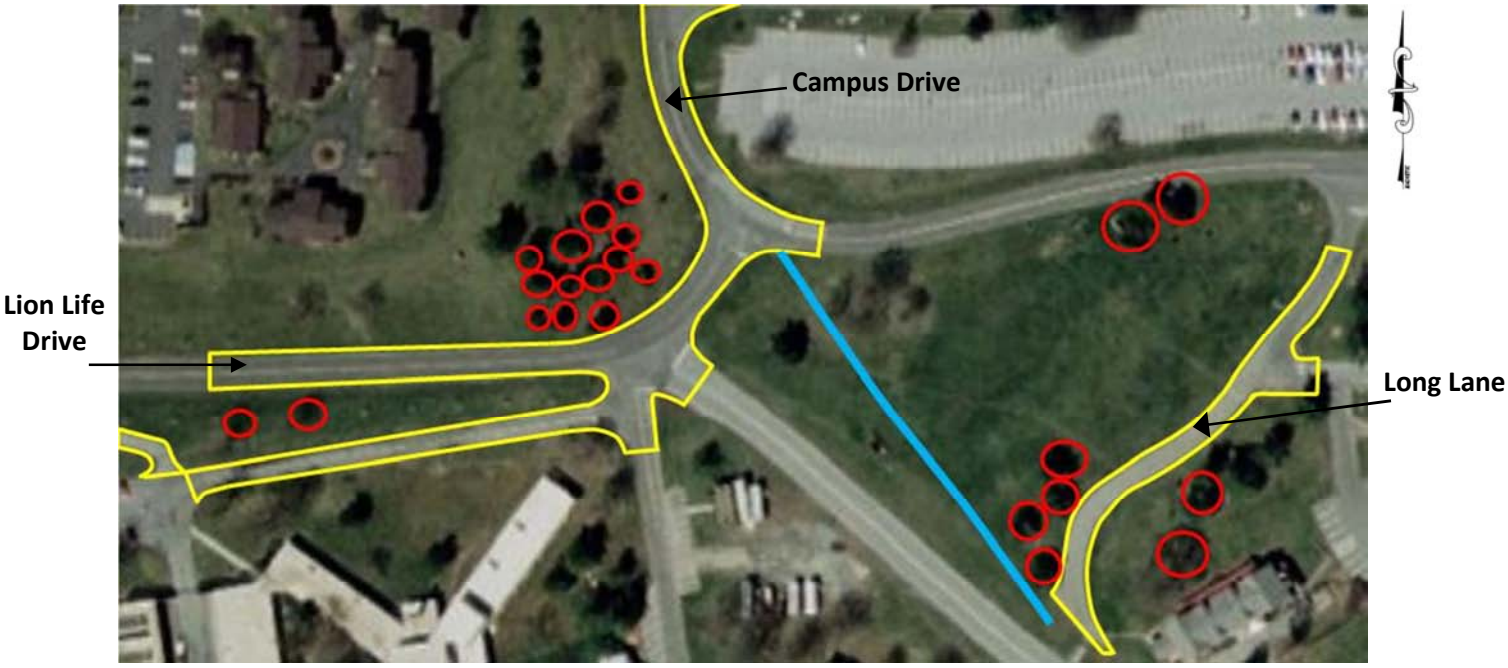


Figure 1: Demolition for Support Services Building

LEGEND

- Limit of asphalt paving to be removed
- 18" underground corrugated metal storm drainage pipe to be removed
- Tree to be removed

STRUCTURAL STEEL

Acting as the skeletal backbone of the Support Services Building is a rigid steel superstructure. All structural steel on the project is ASTM 992. Typical beam to column moment connections can be seen in figures 2 and 3 below. The lateral loads are transferred through the structure to micropile foundation system where 60 of the 152 piles are battered. Although this system provides the primary resistance to lateral forces, the masonry elevator shafts and stair towers also provide lateral support.

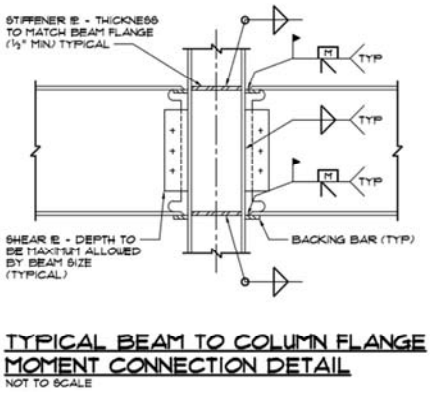


Figure 2: Typical Beam to Column Flange Detail

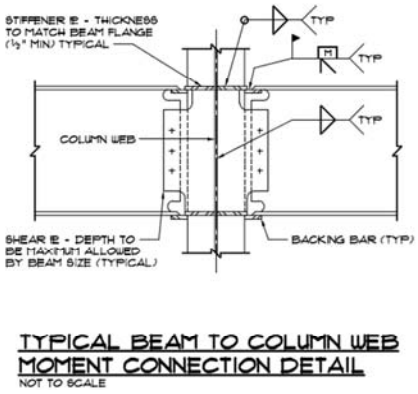


Figure 3: Typical Beam to Column Web Detail

Due to the primary function of the building and interior layout, all bay sizes are different with the largest bay being 31'x36'. Typical column sizes are W10x33 except for the 11 columns surrounding the 3,000 SF, 2-story Central Campus Storage in the center of the building. These 11 columns are the some heaviest pieces of structural steel in the project at over 2 ton/piece. Typical beam and girder sizes are W21x44, W14x22, and W18x35. The lower and upper roofs are supported by a combination of K-Series steel joists, except for the 3,000SF roof above the Central Campus Storage. It is supported by wide flange beams in order to support the weight of the three roof top units (RTU's) and two make-up air units (MAU's) located above.

Elevated floor slab construction in the Support Services Building is composite. The 3 ½" normal weight concrete slabs are supported by 2" Lok-Floor 19 gauge galvanized composite floor deck. This decking allows for unshored triple span construction for up to 9'-2". ¾" shear studs welded to the beams and W6x6 W2.9x2.9 WWF reinforcing make up the final components to the composite slabs.

To support the cold applied asphalt roof, 1 ½" wide rib 22 gauge galvanized metal roof deck was used. Atop the metal roof deck is 2 layers of 2" rigid insulation, ¼" dens-deck sheathing, and the layer of the cold applied asphalt roofing. This particular roofing system was chosen by the architect and owner to help the project meet its goal of LEED Certification. It is highly durable, reduces energy consumption, reduces heat island effect, and is made from 30% post consumer recycled content.

To erect the Support Services Building the construction team will utilize a 100-ton crawler crane. The crane will be able to track back and forth in the parking lot on the north side of the building (See figure 4 at right). The parking lot also provides ample room for deliveries and material lay-down areas.

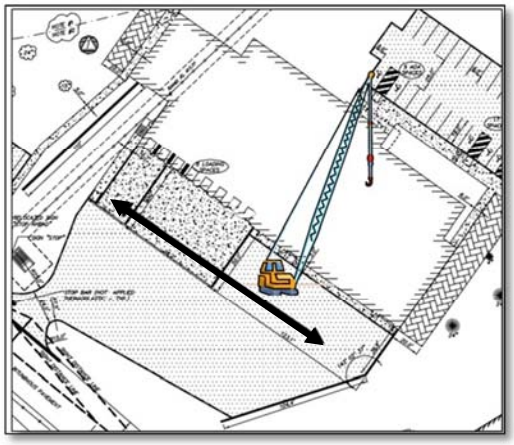


Figure 4: SSB Crane Location

CAST-IN-PLACE CONCRETE

Reinforced cast-in place concrete is utilized for pile caps, foundation walls, slab on grade, elevated slabs, and exterior site retaining walls. All concrete on the project is 4,000 PSI except for the elevated slabs which are 3,500 PSI concrete. All vertical formwork used on the project is Western Forms Flagship Elite series aluminum panels Typical panel sizes are 2'x2', 2'x4', and 2'x8'. Figure 5 below represents the features of a typical panel. All horizontal formwork is at the discrepancy of the subcontractor. Typically dimensional lumber is utilized however metal is sometimes used (see figure 6 below). The formwork for the elevated slabs is a typical pour stop installed by the steel subcontractor.

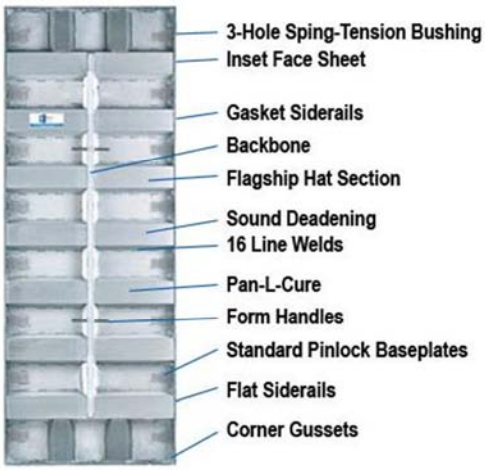


Figure 5: Western Forms Flagship Elite Series Aluminum Panel. Image taken from westernforms.com

Figure 6: Dimensional Lumber Formwork at Top of Pile Cap

MECHANICAL SYSTEM

The primary mechanical system for the Support Services Building is a VAV system with reheat coils located at each VAV. In total the system contains 44 VAV's capable of providing between 150 – 1,340 CFM. At the heart of the VAV system is the three roof top units (RTU's) and two condensing boilers. Total the three RTU's have a 136 Ton cooling capacity, 1,214 MBH heating capacity and are capable of providing 30,000 CFM's to the building. Located in the mechanical room on the second floor, each boiler is capable of providing 45 GPM at 140° supply water temperature which is equivalent to 705 MBH.

To help maintain a high indoor air quality the Support Services Building is also equipped with a total of 18 exhaust fans ranging in size from 100 – 2000 CFM to keep harmful contaminants from re-entering the air system. The Support Services Building also has two rooftop make-up air units (MAU) that service the Paint Shop and Open Dock Area. To help achieve the LEED Certified rating the boilers and (MAU's) on the project are run off natural gas and all filers have a MERV-8 rating.

Located in the stair towers and vestibules are Cabinet Unit Heaters (CUH) to help heat these spaces. There are for different CUH's on the project ranging in size from 670 – 1210 CFM. To cool the IT rooms, and cool/heat the electrical and elevator machine rooms there is total of five ductless Air Conditioning Units (ACC) which are each individually connected to an Air Cooled Condensing/Heat Pump Unit (CNU) on the roof. All units have an energy efficiency rating of 16 SEER. The ACC's and CNU's for the two IT rooms are capable of providing 1 ton of cooling each. The ACC and CNU servicing the electrical room is capable of providing 1.5 tons of cooling and 20,400 BTUs of heating. Lastly the two ACC's and CNU's

servicing the two elevator machine rooms are capable of providing 3/4 ton cooling and 12,200 BTU's of heating.

There are two types of fire protection systems for the Support Services Building. The final design of both is the responsibility of the Fire Protection subcontractor. The first type of system is an Early Suppression Fast Response (ESFR) and is located in the Central Campus Storage in the center of the building. The remaining parts of the building will be covered by a wet-sprinkler system with the tunnel level and 1st floor being classified as Ordinary Hazard Group 2. The 2nd floor is classified as Light Hazard Group.

ELECTRICAL

PSUHMC's Support Services Building gets it power from an existing electrical ductbank that traverses the eastern side of the site. From the ductbank, the primary source (3 #300 KCMIL 15KV EPR cables) and the secondary source (3# 500 KCMIL EPR cables) feed into a PMH-9 Sectionalizing Switch with automatic source transfer control. From the sectionalizing switch 3 #2 15KV EPR cables run to an owner supplied 500KVA transformer. The primary side of the transformer takes the 13.8 KV incoming feed and is stepped down to 277/480V-3Ø on the secondary side feed to building.

From the transformer 2 sets of 4#350KCMIL run to the 600A main distribution panel inside the electrical room located on the 1st floor. From the main distribution panel the power is distributed to either the 3 Roof Top Units (RTU's), 2 elevators, one of 5 panelboards, or to a 150KVA transformer to step the power down to 208Y/120. From the 150KVA transformer the 208Y/120 is distributed to an additional 8 panelboards.

MASONRY

The Support Services Building has a combination of load bearing masonry walls, non-load bearing interior masonry walls, and masonry veneer. The two elevator shafts and three exterior stair towers are constructed of load bearing CMU walls. Two stair towers, stair 1 on the north side and stair 3 on the east side have 12" CMU exterior walls with a 4" Arriscraft Masonry Veneer with a deep sandblasted finish, color Driftwood. The masonry veneer is also carried around the lower portion of the building. The veneer is attached to the building using conventional masonry anchors ever 2 courses of CMU. Figure 7 at right show a finish and color sample of the stone veneer.

Figure 7: 4" Arriscraft Masonry Veneer w/ Deep Sandblasted Finish, Color Driftwood

Many of the first level interior walls are non-load bearing 8" CMU walls. This type of wall was chosen for its durably and for its 1-hr fire rating to separate all of the storage areas/shops. Beneath each CMU wall the SOG is haunched to support the weight of the wall. Several of the walls on the second level are also non-loading bearing CMU walls. Located directly underneath the CMU walls on elevated slabs is a steel beam to support the weight of the wall. To keep the wall from moving #5 dowels are drilled and grouted into the slab every 48" (See figure 8 on next page).

To erect the CMU walls and apply the stone veneer the construction team will utilize both conventional scaffolding and hydro-mobile scaffolding. Interior CMU walls will be constructed off conventional scaffolding stacked as high as needed. The exterior walls and veneer will be constructed off the hydro-mobile scaffolding. Figure 9 on the next page shows a typical hydro-mobile scaffolding system.

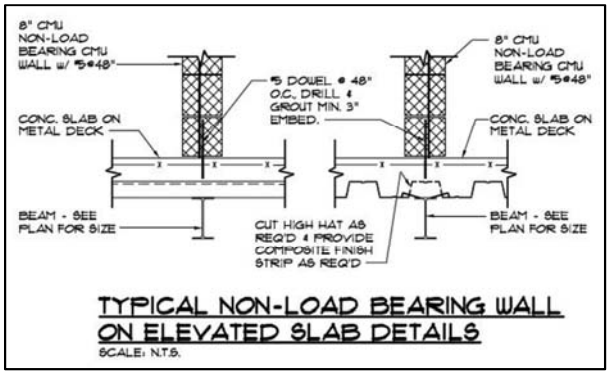


Figure 8: Typical Non-Load Bearing CMU Wall on Elevated Slab Detail

Figure 9: Typical Hydro-Mobile Scaffolding. Image taken from hydro-mobile.com

CURTAIN WALL

Encasing the exterior of stair 2 in the northwest corner of the building and the vestibule on the north side of building is a two-story glass curtain wall system. The system chosen by the architect (Highland Associates) is a Kawneer 1600 series which features 2½" x 7 ½" aluminum members. For glazing the architect chose a 1" Solorban 60, color Atlantic (green-tinted) by PPG Industries, Inc. The stick-built system will be erected by the installer (Browns Glass) to within a 1/8" in 10 feet plumb tolerance and 1/8" in 20 feet level tolerance.

EXCAVATION SUPPORT

Due to a 20 foot change in elevation across the Support Services Building site and construction around an existing utility tunnel, soldier beam & lagging and underpinning are being used for excavation support on the project. Unique to the project both systems are combined into one hybrid system for support at the existing tunnel. Figure 10 below shows the installation of a steel soldier pile at the existing tunnel.

To support the existing tunnel footer, a steel bracket is welded to the steel soldier beam underneath the bottom of the tunnel footer and the entire system is encased in concrete (see figure 11 at right). 3" hardwood lagging is then place between the steel beams on the excavation side.

Figure 10: Steel Soldier Pile Installation at Existing Tunnel

In the southwestern part of the site soldier beams and lagging was also used for support where existing trees prohibited the slope of the excavation to be achieved. Typically these systems will be cut off 3 feet below grade and the remaining portion left in the ground.

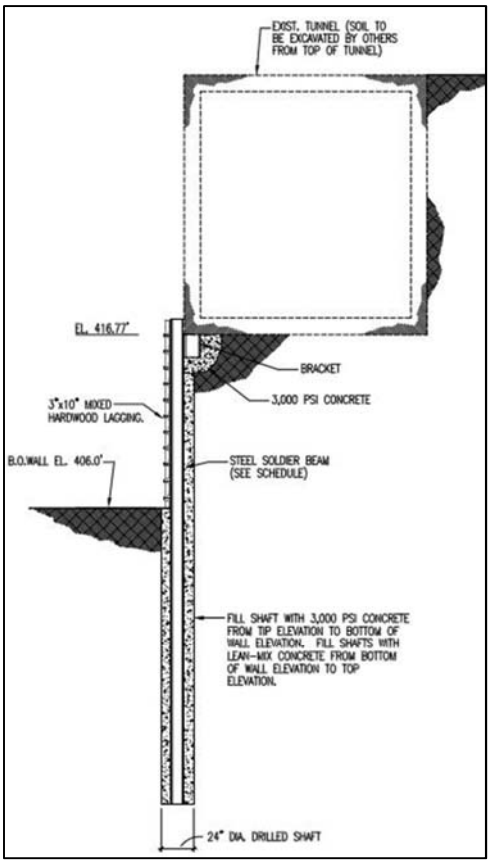


Figure 11: Hybrid of Soldier Beam and Underpinning System at Existing Tunnel

PROJECT COST EVALUATION

Actual construction costs are based on 8/5/2010 GMP estimate by the CM (Alexander Building Construction Co.). To date most of the project has been bought out therefore costs reflect subcontractor bid amounts and ABC estimates.

PROJECT PARAMETERS

Square Footage:	42,796 SF
Building Perimeter:	735 LF

CONSTRUCTION COSTS (CC)

Actual:	$10,534,083
Per SF:	$246.15

TOTAL CONSTRUCTION COSTS (TC)*

Actual:	$14,395,331
Per SF:	$336.37

***Note:** $650,000 of allowances included in total construction costs.

MAJOR BUILDING SYSTEMS COSTS ESTIMATE

MAJOR BUILDING SYSTEMS			
Micropiles	$793,301	$18.54	Coastal Drilling East, LLC
Cast-In-Place Concrete	$794,887	$18.57	Waggoner Construction
Masonry	$854,900	$19.98	Caretti, Inc.
Structural Steel & Misc. Metals	$819,529	$19.15	Ritner Steel, Inc.
Roofing and Waterproofing	$642,633	$15.02	Warko Roofing
Aluminum, Glass, & Glazing	$139,150	$3.25	Browns Glass
Centria Metal Panels	$635,810	$14.86	ABC Estimate
Gypsum Board Assemblies	$487,000	$11.38	GEM Wall
Interior Finishes	$585,532	$13,68	ABC Estimate
Electric Traction Elevators	$569,600	$13.31	ThyssenKrupp Elevators
Fire Protection	$114,500	$2.67	Victory Fire Protection
Plumbing	$381,863	$8.92	Warko Group - Plumbing
HVAC	$1,262,096	$29.49	Warko Group - HVAC
Electrical	$1,465,780	$34.25	Cavanaugh Electrical Contracting, Inc.

Table 2: Major Building Systems Cost Estimate

D4COST COST ESTIMATE – Construction Costs

*** See APPENDIX C for D4COST V9.5 Estimate Reports**

- **Case #EU070948 - University Sciences Building**

  Actual: $6,735,900
  Per SF: $169.35

  Note: Project was chosen for its size, number of floors, exterior finish, foundation type, and roofing type.

- **Case # CV961125 - Houston TranStar Traffic Mgt Ctr**

  Actual: $5,800,316
  Per SF: $109.44

  Note: Project was chosen for its size, building function, foundation type, and roofing type.

RS MEANS SQUARE FOOT ESTIMATE – Construction Cost

*** See APPENDIX B for RSMeans CostWorks 2010 Square Foot Estimate Reports**

- **Square Foot Estimate 1: Vocational School w/ Metal Sandwich Panels & Steel Frame**

  Actual: $4,670,000
  Per SF: $109.12

Building type was chosen based on exterior finish and typically vocational schools have specialty shops (ie. metal shop, paint shop, etc.) that the Support Services Building also has. Two hydraulic passenger elevators totaling $236,000 were added to the standard square foot estimate to account for the two elevators in the Support Services Building.

- **Square Foot Estimate 2: Computer Data Center w/ Brick Veneer & Steel Frame**

  Actual: $8,750,500
  Per SF: $204.47

Building type was chosen due to amount of masonry used for construction, higher complexity of building systems, and industrial interior building finishes similar to the Support Services Building. A surveillance system with 4 cameras was added to account for the 4 exterior security cameras on the Support Services Building.

COST COMPARISON

Due to the nature and function of the Support Services Building, two different estimates were developed from both RS Means and D4Costs in order to gain a more accurate cost comparison. To compare the estimates, the total project costs cannot be considered because D4Cost and RSMeans do not include sitework, allowances, fees, insurance, etc., in their estimates. For an accurate comparison actual construction costs were compared against the D4Cost and RSMeans estimates.

Of the four conceptual estimates, the second square foot estimate from RSMeans (Computer data center w/ brick veneer & steel frame) was the closest to the actual construction costs at just under $1.8 million below. However, the Support Services Building only has about 20% of its exterior façade covered in masonry veneer and it doesn't require the complex computer systems of the computer data center. Another major difference between the two is RSMeans makes the assumption that the project will be constructed on spread footings, whereas the Support Services Building will be constructed on micropiles and grade beams.

The first square foot estimate from RSMeans (Vocational school w/ metal panels & steel frame) is a closer match to the actual Support Services Building. Both buildings are clad in metal panels with a steel superstructure and have a number of specially shops. However the estimate from RSMeans was over $5.8 million below the actual construction costs. Again RSMeans makes the assumption of spread footings whereas the actual project is being constructed on micropiles and grade beams. The support Services Building also has masonry veneer and glass curtain wall on the exterior façade that isn't accounted for in the RSMeans estimate.

Both RSMeans estimates don't account for the associated costs with construction above and around the existing utility tunnel, the amount of interior masonry walls, and systems such as the paint booth and high-pressure spray system in the Support Services Building. Although the square foot estimating software is a good tool to obtain a "ballpark" estimate for a basic building, it is hard to determine an accurate estimate for buildings that use more complex construction methods, a variety of finishes, and have a number of unique systems like the Support Services Building.

In comparison the same issues with the RSMeans estimates were encountered with the D4Cost parametric estimates. Although the database of projects is very large (over 1,500 projects), it is very difficult to find a project with the same building parameters as the Support Services Building. The function of the building provided the biggest headache. There wasn't a project in the D4Cost database that served as a maintenance support facility, office space, and storage for a medical center campus. D4Cost also doesn't account for the associated costs of construction around an existing utility tunnel.

Of the two D4Cost estimates, the first case study (#EU070948 - University Sciences Building) was the closest to the actual construction costs at just under $3.8 million below. This project was also the closest to the actual Support Services Building in square footage, foundation walls, exterior facades, and roofing type. The second case study (#CV961125 - Houston TranStar Traffic Mgt Ctr) also had similar features but was over $4.7 million below. Again the major differences in costs between the actual and D4 cost are mentioned above. Also, the Support Services Building is pursuing a LEED Certified rating and the up-front costs associated with this are not reflected in the D4Cost estimates. D4Cost is a good tool for basic buildings, but as in the case with the RSMeans estimates, is difficult to get an accurate estimate for a more complex project.

SITE PLAN OF EXISTING CONDITIONS

***See APPENDIX D for Existing Conditions Site Plan**

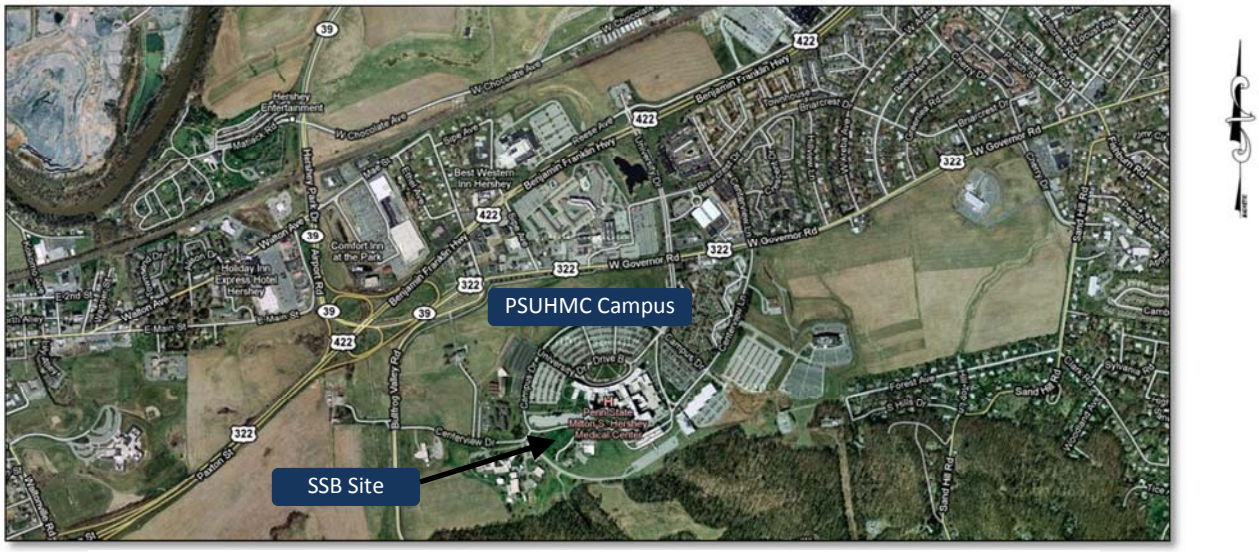


Figure 12: Arial View of Penn State Milton S. Hershey Medical Center & Surrounding Area.
Image taken from Google Maps

The Support Services Building is being built on a triangular shaped site on the southwestern part of the medical center's campus. It is bordered on three sides by the following roads; Campus Drive, Long Lane, and Lion Life Drive. Also bordering the site is the NMR Research Facility (1-story) to the east and the Long Lane Building (2-story) to the south. Directly underneath the site (8-10 feet below grade) is a utility tunnel which houses the main steam and chilled water lines to the main hospital. The tunnel also serves as an access path for pedestrians and material distribution from the Animal Research Facility (ARF), Boiler Plant, and the existing loading dock/hospital. Construction in and around the tunnel will have to be closely monitored to maintain the integrity of the tunnel and the utilities within it.

Another major part of the project is the re-alignment of Campus Drive. Currently 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 main access point to the hospital from west, the intersection quickly backs up during shift changes at the medical center. This is also the route in which all the medical supplies are delivered to the hospital. Figure 12 at right shows what the new intersection will look like. Due to the fact that Lion Life Drive is a major access point to the medical center, Hershey Medical Center has made it a point that at no time can access be restricted from Lion Life Drive therefore detailed planning and construction of temporary roads will be necessary to keep traffic flowing.

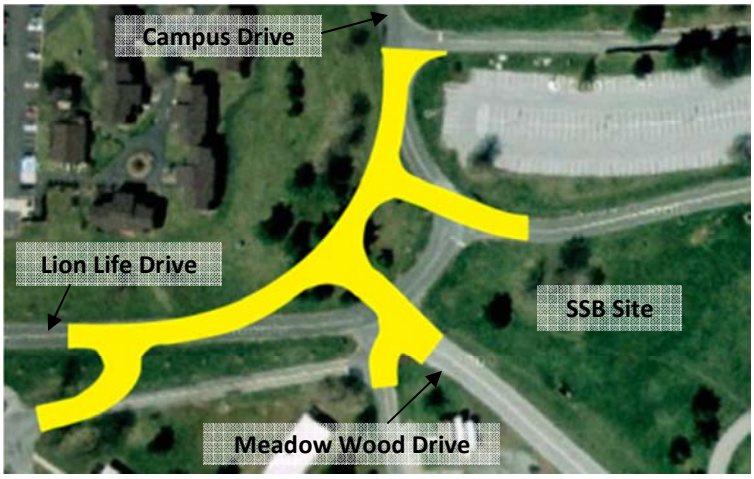


Figure 13: Campus Drive Re-Alignment

LOCAL CONDITIONS

Penn State Hershey Medical Center is located just past Hummelstown, PA in Hershey PA where US Route 422 splits off from US Route 322 approximately 15 miles from downtown Harrisburg. The area can be extremely difficult to build on due to the unpredictability of the karst bedrock formation known as the Epler Formation. Sinkholes are a common occurrence on every jobsite. With the varying depth of bedrock typically micropiles are used as a deep foundation system in the area and/or some method of soil improvement is also required. Typically all new construction in the area utilizes a steel superstructure due to local building practices.

Due to the fact that Hershey Medical Centers is a major medical research facility that's serves a major portion of central Pennsylvania and houses the Penn State School of Medicine, parking in the hospitals parking lots in prohibited to contractors. With the triangular shaped site, space is a premium. To alleviate congestion all contractor trailers and parking will be located west of the site in Lot W off Lion Life Drive (See figure 14 below) except for the CM trailer and staff parking. The lot will also be utilized as a construction staging area.

Figure 14: Lot W Contractor Parking & Staging Area. Image taken from Yahoo Maps

From the Geotechnical Report the soils on the site are Bedington shaley silt which is known for is deep, well drained soil colluviums. As predicted the subsurface test borings showed the un-predictability of the bedrock formation. Eight test borings were taken and depth to bedrock varied from 31 feet to 56 feet across the site. However it has been found by prior experience on the medical campus for that number to increase within a few feet from the test boring. The borings also found than underneath the 4-5 inches of topsoil is a layer of silty sand (SM) with gravel ranging from 1-18 feet below grade. Below that is a layer of silt with sand (ML) extending down to bedrock. It is for this reason that the Geotechnical Report recommended the building be constructed on micropiles.

In the Harrisburgh/Hershey area a typical 30YD dumpster costs $300 per offload and $50/ton for the contents. A 30YD dumpster typically holds around 5 ton of debris for a total of $550 per offload. In the past Alexander has found that dumpsters used for recycled materials (wood, metal, etc.) pay for themselves. Alexander figured that with 75% of construction waste being recycled to help achieve a LEED Certified rating, a dumpster full of non-recyclable material will need to be emptied every 2 weeks.

CLIENT INFORMATION

Penn State Milton S. Hershey Medical Center is a state-of the-art research hospital and a branch campus of The Pennsylvania State University that houses the university's College of Medicine. Founded in 1966 by the Pennsylvania State University in large parts from a $50 million dollar gift from the Milton S. Hershey Foundation, the medical center has grown to over 550 acres, 8,800 employees, and the College of Medicine emits over 600 students annually. Overseeing the project for the University/Medical Center is the Office of the Physical Plant (OPP).

In order to meet the demands of the aging/expanding medical center, several years ago the University's Board of Trustees approved the construction of several new buildings. One of those buildings was the Support Services Building. Seeing that the original shipping/receiving dock located underneath the main hospital was outdated, congested, and inefficient the decision was made to relocate the main shipping/receiving dock as well as many of the medical center's support services to their own separate building. The new building will be able to keep up with the demands of the growing medical center.

Given the high profile of the university, expectations are high for all of their projects. High quality of workmanship, higher end finishes, and completion on time and budget are a staple to any of the University's project. The Support Services Building is no exception to this.

Unique to this project, the demands to finish on time and budget are extremely high due to the fact that this project won't generate any revenue for the university/medical center. The university has budgeted a certain amount for the project and any overrun would cause the university to go over its annual budget. Also, due to a prior project on the medical center's campus that finished $20 million over budget, the University has made it clear they are looking to recover some of that $20 million on the Support Services Building project and 2 others on the medical center campus. Running over the expected completion date won't necessarily place a burden on the medical center; however it could possibly ruin a good working relationship between the contractor and the University.

As in all projects built by the university public safety and well being is key concern. Construction on the medical center campus however has even higher demands when compared to the other campuses. Unique to the medical center, all projects must follow ICRA (Infectious Disease Risk Assessment) guidelines. Every contractor must have a minimum of their foreman/superintendent go through an ICRA training class when working on the medical center campus, and projects in and around the main hospital require all employees to be trained. The medical center also prohibits large deliveries during specific hours (6:30A.M-8:30A.M & 3:30P.M.-6:00P.M.) in order to keep congestion down during shift changes. The medical center is also very stringent on the cleanliness of their roads. Tire washes are required on any project where open earth is exposed and often a full-time street sweeper is required. Knowing all of this is vital before any contractor considers working at the medical center.

As described in the Project Summary Schedule section there are two keys parts to the Support Services Building project; the construction of the Support Services Building and the re-alignment of Campus Drive. Construction of both started in June 2010 with the road re-alignment broken into seven small phases in order to keep the road open. It is vital for Alexander to understand the high demands of the university/ medical center and manage their subcontractors to stay on budget and schedule throughout the entire project to keep it moving smoothly, and maintain their good working relationship with the university.

Project Delivery System

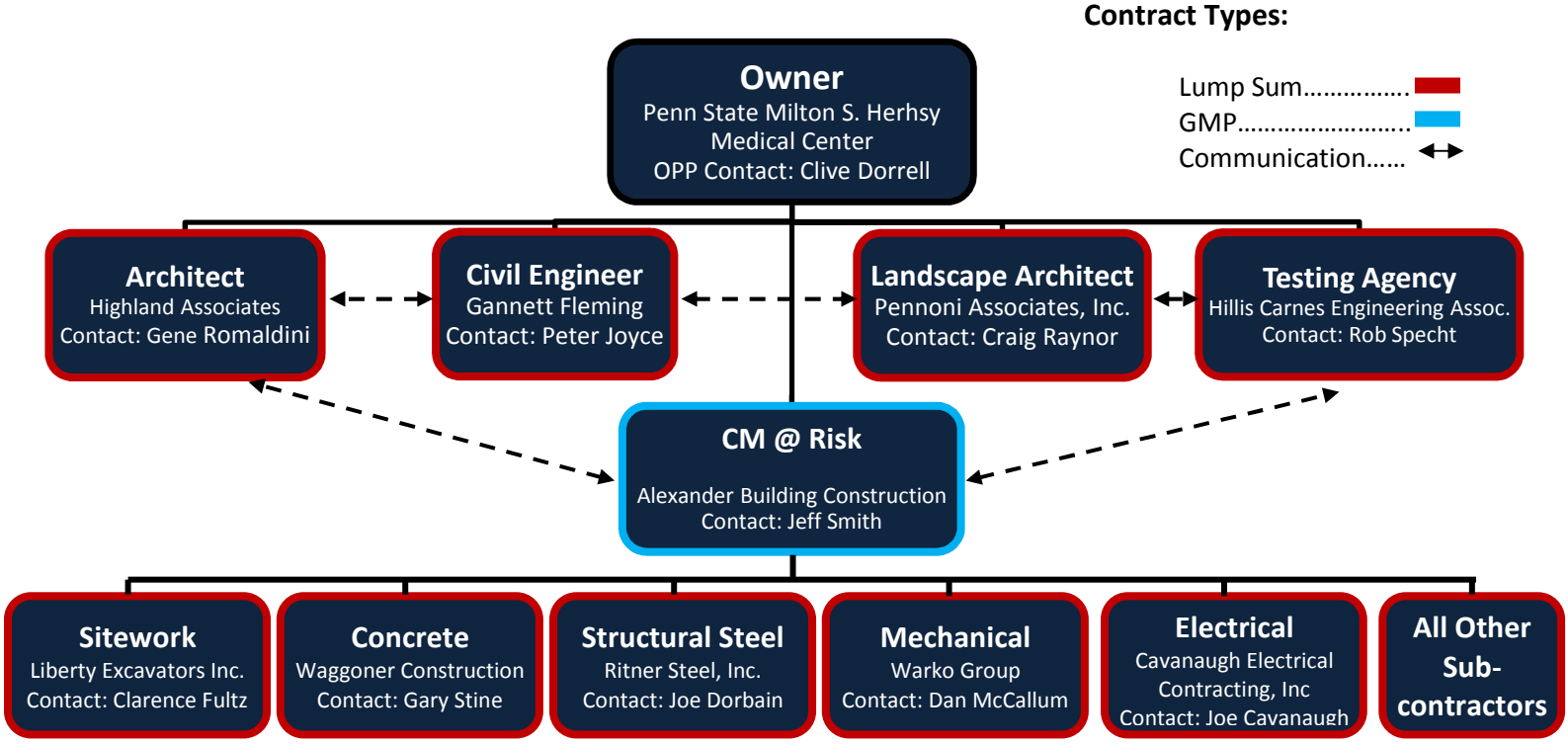


Figure 15: Project Organization Chart

Penn State Milton S. Hershey Medical Center's Support Services Building is being built using the traditional **Design-Bid-Build** delivery method. Alexander Building Construction Co. is the CM at Risk for the project with a negotiated guaranteed maximum price (GMP) that was agreed upon once the project had been bought out. Included in the GMP are allowances to deal with unforeseen site issues such as unsuitable soils and sinkholes which are prone to the area. Traditionally the Design-Bid-Build delivery method is used on all of the major construction projects for the university. Because of the Support Services Building size and complexity this type of delivery method is appropriate. Only subcontractors prequalified by both Alexander and Penn State were permitted to bid on the project. After holding scope review meetings with the three lowest bidders per bid package, a final lump sum contract was awarded to whomever Alexander and PSU selected. Typically the contract was awarded to the lowest bidder. Figure 15 above represents the contractual organization and lines of commutation of the project.

On the project, Alexander was required to submit a payment a Performance and Payment bond to university. In addition all subcontractors whose contract was greater than $1 million or was determined critical to the project was also required to submit a performance and payment bond. Builders Risk Insurance for the project is provided by the University and Alexander is providing the General Liability Insurance. The University/Hershey Medical Center has also requested that the project use 10% of WBE/DBE/MBE participation. Each subcontractor was required to submit a form with their bid showing the amount of participation they intend to use.

STAFFING PLAN

ALEXANDER CORPORATE SUPPORT

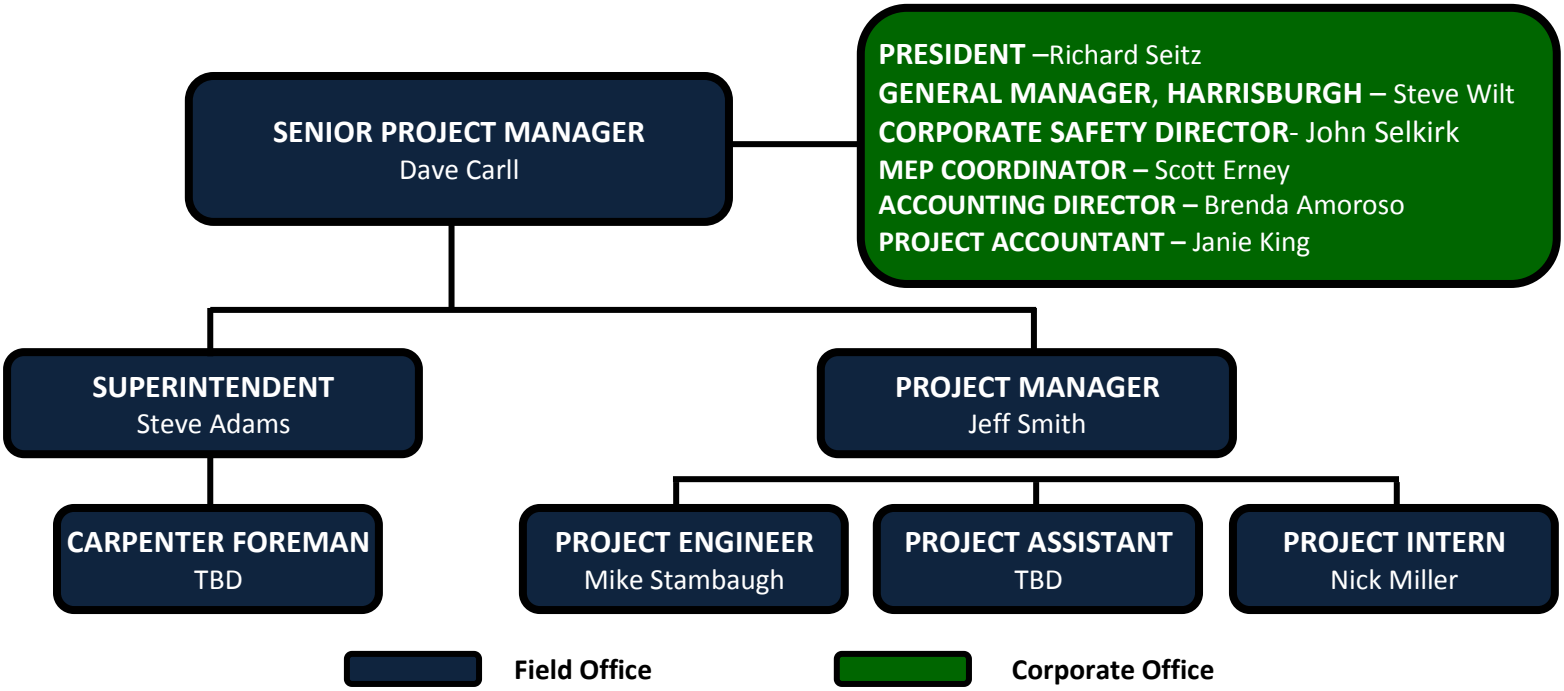


Figure 16: CM Staffing Plan

Alexander Building Construction Co. staffs their project based on project size and complexity. On a project such as the Support Services Building Alexander will utilize a Senior Project Manager, Superintendent, Project Manager, Project Engineer, and Project Assistant. Project permitting they will also utilize a Carpenter Foreman and an Intern. Behind all of their projects is a team of corporate support personnel located in the company's corporate office in Harrisburg, PA as shown in figure 16 above.

At Alexander a Senior Project Manager is typically responsible for over-seeing 3 - 4 projects. Typically a Senior PM is onsite 2 days a week. A Project Manager is responsible for over-seeing 1 - 3 projects and is generally onsite 3 - 4 days a week depending on project size and complexity. Superintendents are only responsible for one project at a time and on smaller projects can be the only team member onsite. Typically a Project Engineer is responsible for one project but can sometimes be responsible for more than one. Generally they work onsite 5 days a week depending on the project. On their larger project's Alexander will add a Project Assistant and an intern.

For the Support Services Building project all personnel shown in blue above in figure 16 are located in the field office located onsite. All other personnel are shown in green and located back at the main office. Once a week the MEP Coordinator and Cooperate Safety Director will visit the site for inspections and meetings. Often the General Manager will also make a weekly visit to check the progress of the project.

APPENDIX A – Project Summary Schedule

SUPPORT SERVICES BUILDING

PENN STATE MILTON S. HERSHEY MEDICAL CENTER - HERSHEY PA

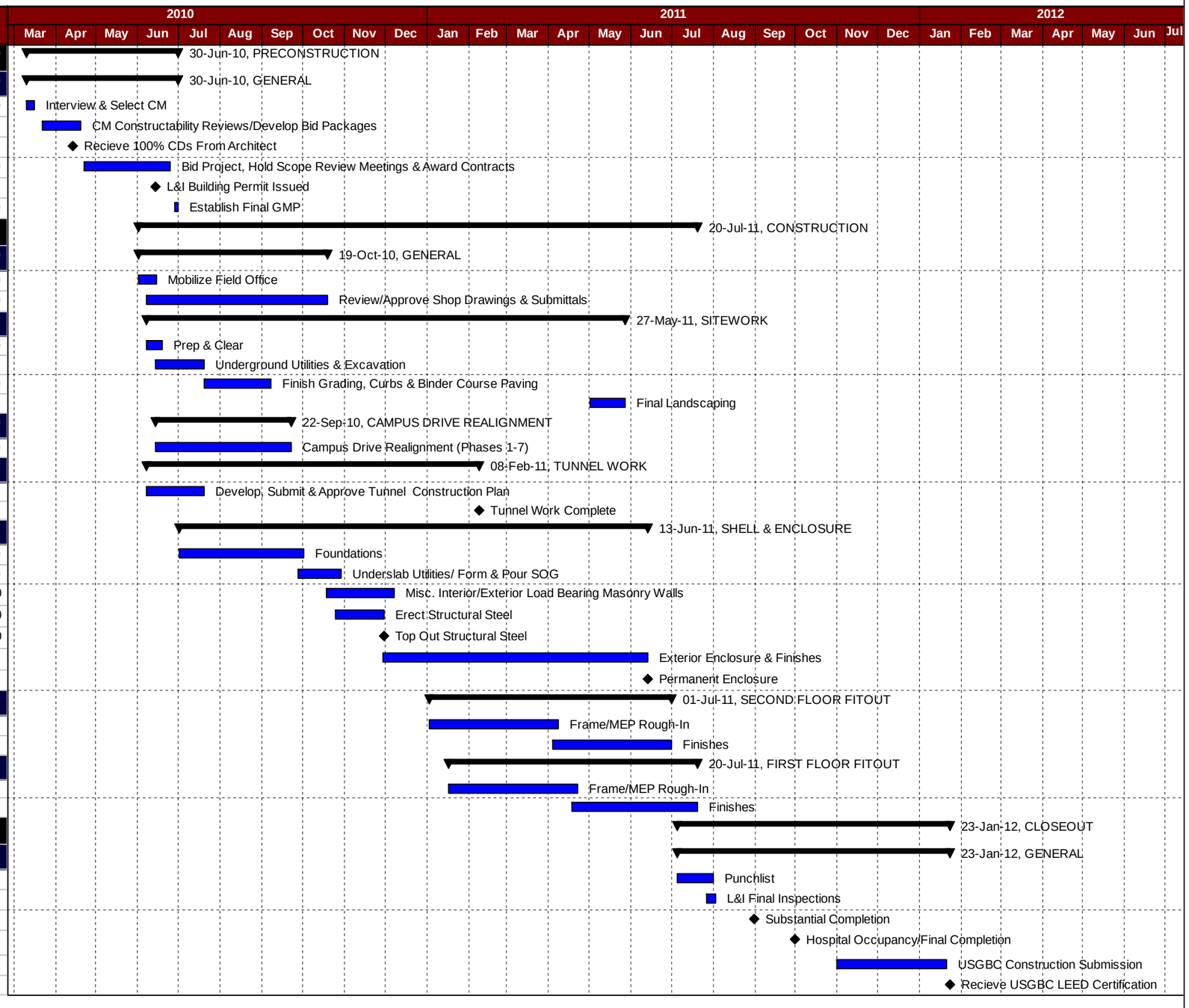
PROJECT SUMMARY SCHEDULE

TECHNICAL ASSIGNMENT 1

WILL LAZRATION

CONSTRUCTION MANAGEMENT

Activity Name	Original Duration	Start	Finish
PRECONSTRUCTION	80	10-Mar-10	30-Jun-10
GENERAL	80	10-Mar-10	30-Jun-10
Interview & Select CM	5	10-Mar-10	16-Mar-10
CM Constructability Reviews/Develop Bid Packages	21	22-Mar-10	19-Apr-10
Recieve 100% CDs From Architect	0		13-Apr-10
Bid Project, Hold Scope Review Meetings & Award Contracts	45	22-Apr-10	24-Jun-10
L&I Building Permit Issued	0	14-Jun-10	
Establish Final GMP	3	28-Jun-10	30-Jun-10
CONSTRUCTION	292	01-Jun-10	20-Jul-11
GENERAL	99	01-Jun-10	19-Oct-10
Mobilize Field Office	10	01-Jun-10	14-Jun-10
Review/Approve Shop Drawings & Submittals	95	07-Jun-10	19-Oct-10
SITEWORK	250	07-Jun-10	27-May-11
Prep & Clear	10	07-Jun-10	18-Jun-10
Underground Utilities & Excavation	25	14-Jun-10	19-Jul-10
Finish Grading, Curbs & Binder Course Paving	35	20-Jul-10	07-Sep-10
Final Landscaping	20	02-May-11	27-May-11
CAMPUS DRIVE REALIGNMENT	71	14-Jun-10	22-Sep-10
Campus Drive Realignment (Phases 1-7)	71	14-Jun-10	22-Sep-10
TUNNEL WORK	172	07-Jun-10	08-Feb-11
Develop, Submit & Approve Tunnel Construction Plan	30	07-Jun-10	19-Jul-10
Tunnel Work Complete	0		08-Feb-11
SHELL & ENCLOSURE	243	01-Jul-10	13-Jun-11
Foundations	65	01-Jul-10	01-Oct-10
Underslab Utilities/ Form & Pour SOG	25	27-Sep-10	29-Oct-10
Misc. Interior/Exterior Load Bearing Masonry Walls	35	18-Oct-10	07-Dec-10
Erect Structural Steel	25	25-Oct-10	30-Nov-10
Top Out Structural Steel	0		30-Nov-10
Exterior Enclosure & Finishes	140	29-Nov-10	13-Jun-11
Permanent Enclosure	0		13-Jun-11
SECOND FLOOR FITOUT	130	03-Jan-11	01-Jul-11
Frame/MEP Rough-In	70	03-Jan-11	08-Apr-11
Finishes	65	04-Apr-11	01-Jul-11
FIRST FLOOR FITOUT	133	17-Jan-11	20-Jul-11
Frame/MEP Rough-In	70	17-Jan-11	22-Apr-11
Finishes	68	18-Apr-11	20-Jul-11
CLOSEOUT	145	05-Jul-11	23-Jan-12
GENERAL	145	05-Jul-11	23-Jan-12
Punchlist	20	05-Jul-11	01-Aug-11
L&I Final Inspections	5	27-Jul-11	02-Aug-11
Substantial Completion	0		31-Aug-11
Hospital Occupancy/Final Completion	0		30-Sep-11
USGBC Construction Submission	60	31-Oct-11	20-Jan-12
Recieve USGBC LEED Certification	0		23-Jan-12



Actual Work | Critical Remaining Work | Summary

Remaining Work | Milestone

APPENDIX B – RSMeans CostWorks 2010 Square Foot Estimate Reports

Square Foot Estimate 1:

Square Foot Cost Estimate Report	
Estimate Name:	**Support Services Building** Penn State Milton S Hershey Medical Center 500 University Drive , Hershey , PA , 17033
Building Type:	**School, Vocational with Metal Sandwich Panel / Steel Frame**
Location:	**HARRISBURG, PA**
Story Count:	**2**
Story Height (L.F.):	**16**
Floor Area (S.F.):	**42796**
Labor Type:	**Union**
Basement Included:	**No**
Data Release:	**Year 2010 Quarter 3**
Cost Per Square Foot:	**$109.12**
Building Cost:	**$4,670,000**

Costs are derived from a building model with basic components.

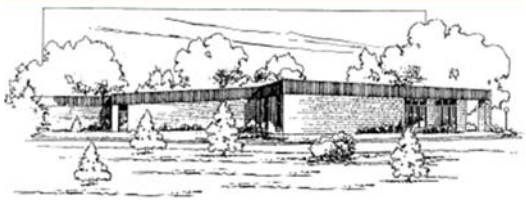
Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per S.F.	Cost
A Substructure		**7.90%**	**$8.65**	**$370,000**
A1010	Standard Foundations		$1.34	$57,500
A1030	Slab on Grade		$5.70	$244,000
A2010	Basement Excavation		$0.09	$4,000
A2020	Basement Walls		$1.51	$64,500
B Shell		**24.40%**	**$26.67**	**$1,141,500**
B1010	Floor Construction		$9.70	$415,000
B1020	Roof Construction		$4.15	$177,500
B2020	Exterior Windows		$8.91	$381,500
B2030	Exterior Doors		$0.51	$22,000
B3010	Roof Coverings		$3.25	$139,000
B3020	Roof Openings		$0.15	$6,500
C Interiors		**21.90%**	**$23.90**	**$1,023,000**
C1010	Partitions		$6.88	$294,500
C1020	Interior Doors		$1.55	$66,500
C1030	Fittings		$1.48	$63,500
C2010	Stair Construction		$1.14	$49,000
C3010	Wall Finishes		$3.26	$139,500
C3020	Floor Finishes		$5.98	$256,000
C3030	Ceiling Finishes		$3.60	$154,000
D Services		**45.60%**	**$49.77**	**$2,130,000**
D1010	Elevators and Lifts		$5.51	$236,000
D2010	Plumbing Fixtures		$4.19	$179,500

D2020	Domestic Water Distribution		$0.83	$35,500
D2040	Rain Water Drainage		$0.70	$30,000
D3010	Energy Supply		$8.84	$378,500
D3030	Cooling Generating Systems		$12.61	$539,500
D4010	Sprinklers		$2.75	$117,500
D4020	Standpipes		$0.75	$32,000
D5010	Electrical Service/Distribution		$1.47	$63,000
D5020	Lighting and Branch Wiring		$9.21	$394,000
D5030	Communications and Security		$2.80	$120,000
D5090	Other Electrical Systems		$0.11	$4,500
E Equipment & Furnishings		0.10%	$0.13	$5,500
E1020	Institutional Equipment		$0.13	$5,500
E1090	Other Equipment		$0.00	$0
F Special Construction		0.00%	$0.00	$0
G Building Sitework		0.00%	$0.00	$0
SubTotal		100%	$109.12	$4,670,000
Contractor Fees (General Conditions,Overhead,Profit)		0.00%	$0.00	$0
Architectural Fees		0.00%	$0.00	$0
User Fees		0.00%	$0.00	$0
Total Building Cost			$109.12	$4,670,000

Square Foot Estimate 2:

Square Foot Cost Estimate Report				
Estimate Name:	Support Services Building Penn State Milton S Hershey Medical Center 500 University Drive , Hershey , PA , 17033			
Building Type:	Computer Data Center with Brick Veneer / Steel Frame			
Location:	HARRISBURG, PA			
Story Count:	2			
Story Height (L.F.):	16			
Floor Area (S.F.):	42796			
Labor Type:	Union			
Basement Included:	No			
Data Release:	Year 2010 Quarter 3			
Cost Per Square Foot:	$204.47			
Building Cost:	$8,750,500			



Costs are derived from a building model with basic components.

Scope differences and market conditions can cause costs to vary significantly.

Parameters are not within the ranges recommended by RSMeans.

	% of Total	Cost Per S.F.	Cost
A Substructure	2.30%	$4.74	$203,000

A1010	Standard Foundations		$1.05	$45,000
A1030	Slab on Grade		$2.25	$96,500
A2010	Basement Excavation		$0.09	$4,000
A2020	Basement Walls		$1.34	$57,500
B Shell		11.00%	$22.56	$965,500
B1020	Roof Construction		$4.12	$176,500
B2010	Exterior Walls		$12.63	$540,500
B2020	Exterior Windows		$1.09	$46,500
B2030	Exterior Doors		$0.90	$38,500
B3010	Roof Coverings		$3.77	$161,500
B3020	Roof Openings		$0.05	$2,000
C Interiors		10.10%	$20.60	$881,500
C1010	Partitions		$3.83	$164,000
C1020	Interior Doors		$1.60	$68,500
C1030	Fittings		$0.43	$18,500
C3010	Wall Finishes		$3.32	$142,000
C3020	Floor Finishes		$5.42	$232,000
C3030	Ceiling Finishes		$5.99	$256,500
D Services		75.50%	$154.45	$6,610,000
D2010	Plumbing Fixtures		$3.52	$150,500
D2020	Domestic Water Distribution		$0.61	$26,000
D2040	Rain Water Drainage		$0.93	$40,000
D3010	Energy Supply		$5.41	$231,500
D3020	Heat Generating Systems		$7.59	$325,000
D3030	Cooling Generating Systems		$8.54	$365,500
D3090	Other HVAC Systems/Equip		$61.43	$2,629,000
D4010	Sprinklers		$3.60	$154,000
D4020	Standpipes		$0.54	$23,000
D5010	Electrical Service/Distribution		$4.12	$176,500
D5020	Lighting and Branch Wiring		$14.18	$607,000
D5030	Communications and Security		$29.41	$1,258,500
D5090	Other Electrical Systems		$14.57	$623,500
F Special Construction		0.90%	$1.93	$82,500
G Building Sitework		0.00%	$0.00	$0
SubTotal		100%	$204.47	$8,750,500
Contractor Fees (General Conditions,Overhead,Profit)		0.00%	$0.00	$0
Architectural Fees		0.00%	$0.00	$0
User Fees		0.00%	$0.00	$0
Total Building Cost			$204.47	$8,750,500

APPENDIX C – D4COST V9.5 ESTIMATE REPORTS

CASE STUDY 1: University Sciences Building

University Sciences Building	
Case Number	EU070948
Project Cost	$6,735,900
Site Size	87,120 SF
Building Use	Educational
Bid Date	1/1/2005
Num Floors	2
Base Month	January
Base Year	2005
Base Location	Morgantown, WV
Projected Month	January
Projected Year	2005
Projected Location	Morgantown, WV
Building Size	39,775 SF
Num Buildings	1
Project Height	42
1st Floor Height	14
1st Floor Size	18,855 SF
Foundation	CON
Exterior Wall	MET
Interior Wall	MSD
Roof Type	BUP
Floor Type	CON
Project Type	NEW
Case Study Firm	Alpha Associates, Incorporated
Case Study Street	209 Prairie Avenue
Case Study City	Morgantown
Case Study State	WV
Case Study Zip	26501

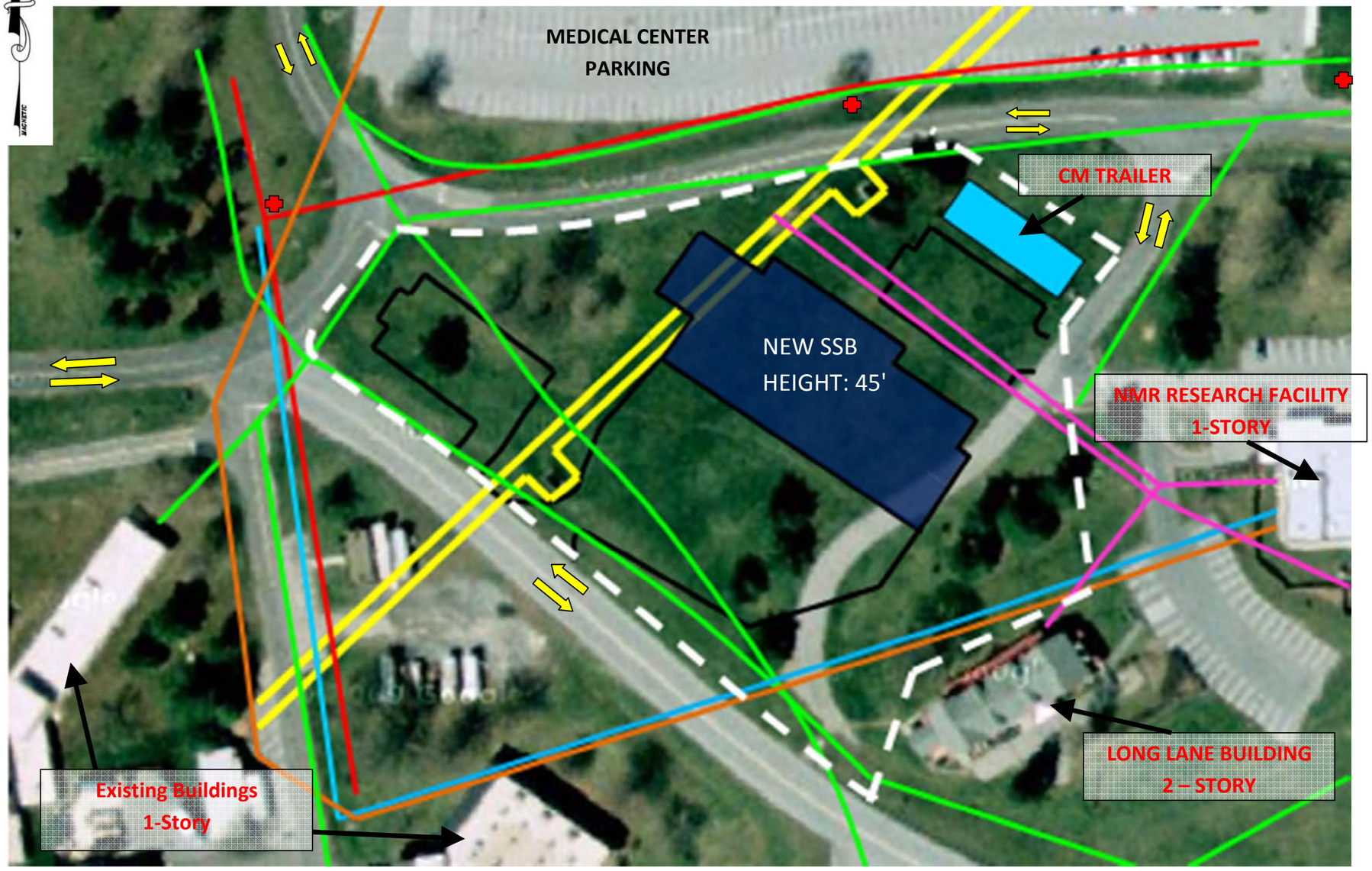
Code	Division Name	%	SF Cost	Projected
01	General Requirements	6.53	$11.06	$440,000
03	Concrete	4.32	$7.32	$291,000
04	Masonry	1.84	$3.12	$124,000
05	Metals	20.41	$34.56	$1,374,600
06	Wood, Plastics, and Composites	0.13	$0.23	$9,000
07	Thermal and Moisture Protection	2.41	$4.08	$162,100
08	Openings	2.38	$4.02	$160,000
09	Finishes	6.08	$10.29	$409,300
10	Specialties	0.27	$0.47	$18,500
11	Equipment	1.55	$2.63	$104,500
12	Furnishings	10.32	$17.47	$695,000
13	Special Construction	0.45	$0.75	$30,000
14	Elevators	0.50	$0.85	$34,000
21	Fire Suppression	1.05	$1.77	$70,500
22	Plumbing	3.29	$5.57	$221,400
23	HVAC	23.66	$40.08	$1,594,000
26	Electrical	13.14	$22.25	$884,900
27	Communications	1.09	$1.85	$73,700
28	Electronic Safety and Security	0.58	$0.99	$39,400
	Total Building Costs	100.00	$169.35	$6,735,900

CASE STUDY 2:
Case# CV961125

Houston TranStar Traffic Mgt Ctr	
Case Number	CV961125
Project Name	Houston TranStar Traffic Mgt Ctr
Project Cost	$5,800,316
Site Size	196,020 SF
Building Use	Civic/Gov.
Bid Date	5/1/1994
Num Floors	2
Historic	True
Base Month	November
Base Year	1994
Base Location	Houston, TX
Projected Month	November
Projected Year	1994
Projected Location	Houston, TX
Building Size	53,000 SF
Auto Calc	True
Num Buildings	1
Project Height	46
1st Floor Size	30,375 SF
Foundation	CON
Exterior Wall	CMU
Interior Wall	CMU
Roof Type	BIT
Floor Type	TER
Project Type	NEW
Case Study Firm	Morris Architects
Case Study Street	3355 W. Alabama, #200
Case Study City	Houston
Case Study State	Texas
Case Study Zip	77099

Code	Division Name	%	SF Cost	Projected
01	General Requirements	0.00	.00	$0
03	Concrete	9.02	$9.87	$522,930
04	Masonry	4.97	$5.44	$288,513
05	Metals	12.02	$13.16	$697,240
06	Wood & Plastics	1.97	$2.15	$114,203
07	Thermal & Moisture Protection	6.11	$6.69	$354,631
08	Doors & Windows	5.91	$6.46	$342,609
09	Finishes	8.29	$9.07	$480,856
10	Specialties	0.52	$0.57	$30,053
11	Equipment	0.21	$0.23	$12,021
12	Furnishings	0.21	$0.23	$12,021
13	Special Construction	1.14	$1.25	$66,118
14	Elevators	0.73	$0.79	$42,075
15	Mechanical	25.28	$27.67	$1,466,608
	Fire Protection	3.83	$4.20	$222,395
	HVAC	15.34	$16.78	$889,582
	Plumbing	6.11	$6.69	$354,631
16	Electrical	23.63	$25.86	$1,370,438
	Total Building Costs	100.00	$109.44	$5,800,316

APPENDIX D – EXISTING CONDITIONS SITE PLAN



LEGEND:

EXISTING UTILITIES:

STORM.....
SANITARY.....
WATER.....
FIRE LINE.....
ELECTRIC.....
EXISTING UTILITY TUNNEL.....

SYMBOLS:

CONSTRUCTION FENCE

VEHICULAR TRAFFIC

FIRE HYDRANT

SUPPORT SERVICES BUILDING

EXISTING CONDITIONS SITE PLAN

September 29, 2010

WILL LAZRATION - CM