Technical Assignment 1

Construction Project Management

The Wilmer Eye Institute Outpatient Surgery & Laboratory Building

Baltimore, Maryland

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Construction Management

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Executive Summary

The key findings in this technical report are as follows:

- All interior tasks in schedule (walls, rough-ins, finishes, etc.) are grouped together by floor and space. The format/sequence of the schedule could potentially be an area that could be improved upon further investigation.
- All systems have been designed to be able to accommodate the load from three extra floors in lieu of future expansion, also causing all HVAC equipment to be located in the basement, aside from some fans on the roof.
- Parts of an old foundation were still underground below the former parking lot and needed to be removed. Spread footings will be earth formed, and all other formwork will be high-grade plywood.
- R.S. Means square foot estimating data is not applicable to large, multi-storey hospital buildings that combine research labs, operating rooms and an outpatient center. D4Cost is advantageous in that it can be ensured that the cost data referenced is from a similar project, whereas R.S Means data is an average of numbers from many projects of same type (but not necessarily size, etc.).
- There is no construction waste recycling. The project is not LEED certified. This a great reason to perform sustainability analysis and find out why these measures are not in place.
- The permitting process on this particular project is long and extensive. This could prove to be a major obstacle when assessing alternative methods.

Other notable facts learned:

- Construction is scheduled to start June 2007 and end October 2009, an expected duration of 28 months.
- Perimeter walls begin on each floor as reshores are removed from floor above. Building skin construction will wrap around building clockwise starting on the north face.
- No dewatering system will be needed, as the water table is 15 feet below the lowest floor elevation.
- Soils on site are mostly existing fill soils from previous projects.
- Building is in a prime location on the Hopkins Medical Campus and will combine eye specialists of all different types from different locations throughout the hospital into one building.

Project Schedule Summary

The foundation work is scheduled to begin on the 24th of October, 2007. Spread footings will be excavated and concrete will be placed directly into the earth form. The installation of column footings and perimeter walls will immediately follow, and eventually waterproofing and backfilling. Tower cranes will also be erected during this time.

The structure of the sub-basement and basement, and each subsequent floor will be constructed in sequence after the foundation and cranes are in place. The slabs for each floor will be put up two days after the columns and walls for the previous floor were poured.

Building enclosure will begin with the perimeter walls. These will begin to be put in place on each floor after the reshoring has been removed from the adjacent floor above. The skin of the building (vapor barrier, brick veneer, glass curtainwall, etc.) will begin about 75% through the perimeter wall process, and will wrap around the building clockwise starting on the north face. As the building becomes enclosed, each of the interior trades will begin their work in sequence as the floors become available, eventually ending with the finishes and construction cleanup.

*The schedule is located in the Appendix at the end of this document.

Building Systems Summary

Demolition / Existing Conditions

There is an existing paved parking lot with gravel base that will need to be removed. It has also been determined that parts of the foundation from the Johns Hopkins Inn (building that occupied the site at an earlier time) were never completely demolished and will need to be removed as they are encountered during excavation.

Structural System / Cast-In-Place Concrete

The building's primary structural system utilizes a mildly reinforced two-way concrete plate system. This basically consists of flat floor plates with additional depth in the form of drop panels near the columns. The typical rectangular shape of the bays works fairly well with this system. Perimeter walls will be modular brick façade with CMU backup. Floor to floor distance is 15'-4" on the first floor, 25' in basement, and 14'-8" on the remaining levels.

Lateral load resistance will require the use of several shear walls. They will be 12" thick and will run from the foundation up to the roof. There will be approximately 70 linear feet of shear wall per floor.

Foundations will be spread footings, machine-excavated and earth formed. All other formwork will be high-grade forming plywood. Concrete will be placed with a combination of pump truck and crane and bucket.

Mechanical System

All HVAC equipment with the exception of the central laboratory exhaust fans will be located at the basement level. The exhaust fans will be located on the roof within a screened enclosure. Outside air for the AHU's in the basement will be ducted from the second floor of the building.

Four 44,000 CFM 100% outdoor air industrial grade air handling units with a 40" diameter DWDI fan sized for 10" static pressure will serve the lab areas (8" static pressure for the clinical floor, and 6" static pressure for the atrium/office area). Four 66" diameter SWSI laboratory exhaust fans sized for 70,000 CFM each will be located on the roof, discharging at 10' above the main roof line.

The maximum steam load, inclusive of process loads, is estimated at 42,000 lb/hr with the incorporation of energy recovery wheels on the laboratory AHU's. A parallel steam reduction station will be used to reduce the incoming steam pressure from 120 PSIG down to 65 PSIG for domestic and industrial steam to hot water converters, as well as down to 15 PSIG for HVAC steam to hot water converters.

Central shafts at either side of the building will convey ductwork and service piping to all of the floors. Terminal units will be located over the areas they serve both in the clinical and laboratory areas.

The building will have complete sprinkler coverage by a combination wet sprinkler-standpipe system. A 1250 GPM electric fire pump will be required to maintain 100 PSI at the top of the standpipe systems, which will be located at the stairwells with floor control valves extending from one stairwell only. The atrium area will be equipped with a deluge system that covers both sides of the structural separation glass between the laboratory and atrium spaces.

Electrical System

Two redundant 13.2 KV feeders from the hospital's distribution network will supply normal operational power. The feeders will be run to the building via rigid steel conduits and underground concrete encased 4" PVC ductbanks. They shall be 15KV shielded size #4/0 with a 600 volt insulated ground conductor.

A double-ended substation will transform the feeder service to 480/277 volt, 3 phase, 4 wire for distribution throughout the building. One 300 KVA transformer will be provided on each floor. A 13.2 KV underground emergency feeder will come from the hospital's South Generator Plant. All transformers have been sized to accommodate a future three-floor expansion. Distribution panel boards rated at 600 amperes will be provided for supply to the branch circuit panel boards located in the laboratories and offices.

The double-ended substation will also include 15 KV fused primary switchgear, 2,500 DVA silicone filled transformers and secondary distribution switchgear.

Masonry

The exterior walls are primarily modular extruded type FBX brick veneer cavity wall construction with CMU backup. Each of the window openings on the south and east walls use jack-arches and brick returns to create an 18-inch deep frame. Window sills will be cast stone. 7-ounce copper laminated type through-wall flashing will be installed in conjunctions with plastic tube type weeps spaced 24"O.C. horizontally. Anchors will be two-piece stainless steel type, spaced 16" O.C. vertically and 24" O.C. horizontally.

Curtain Wall

Typical glazing will consist of 1-inch insulating spectrally selective glass with SHGC (shading heat gain coefficient) exceeding the requirements of ASHREA 90.1. Typical glazed curtain wall windows will be thermally broken, finished in a 3-coat fluoropolymer finish and will be performance tested to the owner's specific criteria.

Support of Excavation

Sheeting and shoring will be required on all four sides of the site, and will consist of drilled soldier piles with wood lagging. Tieback system will be up to two rows of 3-strand auger-cast grouted ties connected to walers.

Water was encountered in the geotechnical study at elevation 31-ft at its highest point. The current lowest floor elevation is at elevation 50-ft, over fifteen feet above the water table. Therefore no dewatering system will need to be in place during construction.

Project Cost Evaluation

Actual Building Construction Cost

$68,146,302 = $337/sf

Total Project Costs

$92,299,693 = $456/sf

Brief Narrative

The figures achieved using R.S. Means Square Foot Estimating Guide (2008) were seemingly very low. This is probably because this building is at least four times larger than a typical hospital or research lab. Also, the prices per square foot referenced in Means are less than half than that of the actual building (compare Means median price for research lab $184/sf to actual $337/sf), so it is of no surprise that this estimate is extremely low.

On the other hand, the numbers produced using D4Cost2000 tended to be extremely accurate (compare D4 cost of construction $ 65,251,655 to actual $68,146,302, a 4.2% difference). This also tends to add up since the cost was referenced from a five-storey, 218,000 square foot hospital building. Essentially, the building referenced with D4 was much more similar to the Wilmer Building than the typical buildings in R.S. Means' database, which is why it makes sense that it would produce a much more accurate estimate.

*The square foot and parametric estimates are located in the Appendix at the end of this document.

Local Conditions

The mildly reinforced two-way concrete plate system is a very common structural framing system in the Baltimore area. There is a planned unit development (PUD) zoning ordinance in the area that limits the height of the buildings to 80'. Concrete plate construction is advantageous in this situation as the floor and beam structure is generally more shallow, creating a larger plenum space and allowing a lower floor-to-floor height. This essentially creates the opportunity for more floors to be constructed in a given building height than a steel frame system. This practice is commonly employed in the Washington D.C. metropolitan area as well as other areas that employ height restrictions.

Similar buildings adjacent to the proposed site are founded on either deep foundations (caissons, piles, etc.) or spread footings. The soil borings surrounding the proposed site suggests that either system would be acceptable for this building. Considering the allowable soil bearing pressure and the cost and time advantages of spread footings over deep foundations, spread footings were chosen for the foundation system.

Whiting-Turner has a small parking lot in front of their offices (which are located in the median space of N. Broadway) for their own staff and project managers. Subcontractors and general construction workers must find parking on their own; there is no designated area for construction parking. There are a few public garages in the area as well as a number of street spaces. Parking in Johns Hopkins Hospital garages is highly discouraged, as they have their own issues with employee parking.

The project is not LEED rated and there is currently no plan for the recycling of construction waste. However there is the possibility that some subcontractors may have their own recycling program in place. We can only hope.

The geotechnical report for the building identifies soil on site to be mostly existing fill soils placed during previous site construction and demolition, and Patuxent Formation soils of the Potomac Group. These Coastal Plain soils are Cretaceous Aged deposits and are locally known to be highly overconsolidated. Below these agents are residual soils and disintegrated rock derived from the physical and chemical weathering of the underlying bedrock. Local geologic maps describe the rock as undifferentiated crystalline rock. Subsurface water was encountered at depths of 43 to 59.5 feet below the ground surface (EL 16.5 to EL 31). As mentioned before, the current lowest floor elevation is at elevation 50-ft, over fifteen feet above the water table. Therefore no dewatering system will need to be in place during construction.

Client Information

The Wilmer Eye Institute is an entity of The Johns Hopkins Hospital and Johns Hopkins Medicine. The institute has been around for 83 years and is world-renowned. Wilmer has always been at the forefront of both laboratory research and clinical testing and treatment of modern eye diseases such as macular degeneration, glaucoma, and corneal disease, among other blinding afflictions.

The institute has essentially outgrown its old building and the technology which it provides. Wilmer's faculty of 80 is currently conducting $25 million worth of federal and other research, and performs more than 8,000 major eye surgeries annually, both inpatient and outpatient.

The building will house an outpatient surgery center with six operating rooms, as well as up to five floors of open research laboratories and support spaces, while also allowing for the possibility of a three-floor future expansion. It has been designed with the intention of meeting a patient demand for over 9,000 annual operations, and will accelerate discovery for the prevention and treatment of blinding diseases, particularly macular degeneration, which is the leading cause of blindness in Americans over the age of 55.

The open-type "laboratories without walls" are intended to create scientific "neighborhoods" and have been designed to get the most out of having many experienced people together in the same area. Surgeons, clinicians, geneticists, epidemiologists, clinical trial specialists, biochemists, molecular biologists and other medical specialists will all be able to work together and share expertise to solve critical problems.

The building is being constructed on the site of a former on-grade parking lot, and is in a prime location, virtually across the street from the main hospital entrance. It will be connected to the adjacent Cancer Research Building I via underground tunnel, and is less than one city block from their current facility. The new Wilmer building is part of a $1.2 billion Johns Hopkins Medicine campus redevelopment program designed to replace existing, aging structures on the 80-acre campus. The centerpiece of the redevelopment is the hospital's New Clinical Building, which consists of two clinical towers, one for cardiovascular and critical care services and one for a children's hospital. The Wilmer building is scheduled to be completed and occupied by mid 2009.

Project Delivery System

The Wilmer Eye Institute project utilizes a traditional design-bid-build project delivery system with The Whiting-Turner Contracting Company. In this situation, all of the subcontracting is handled by the general contractor. This alleviates an extensive amount of time and effort from the owner, as there are many different subs that need to be hired on a job of this magnitude. Johns Hopkins Hospital's Facilities department has trained project managers to oversee the project and protect the interests of the institution, but they do not have the capacity to handle all of the functions of a licensed general contractor.

The contract for the construction of the building is a negotiated guaranteed maximum price (GMP). This protects the hospital from paying more than was agreed in most situations, although there can be changes made to the agreed amount if they are legitimate.

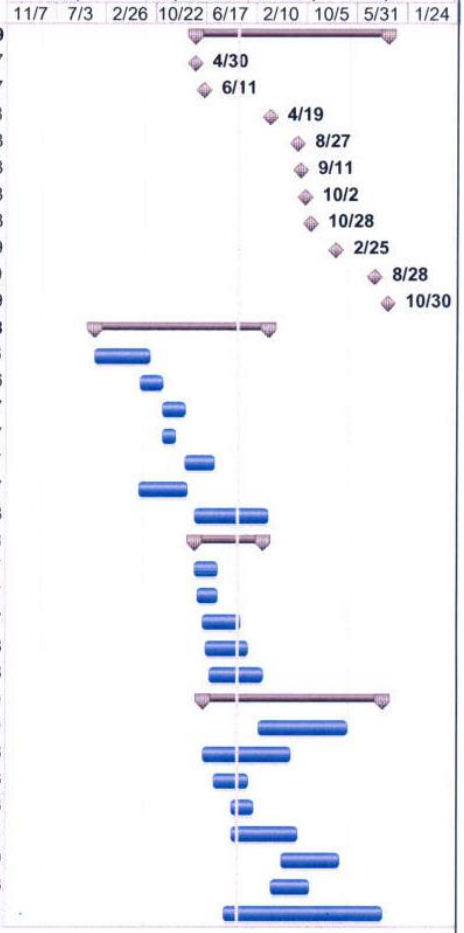
It should be noted that the permitting process in this particular project is quite extensive. Baltimore City has a number of regulations that must be adhered to, and being on Johns Hopkins Medical Campus brings yet more requirements. For one, there is fee to tap into the city's utilities that essentially must be paid throughout the entire duration of the project. Hopkins also had to provide a bond to the Department of Public Works to ensure that they would maintain proper storm water drainage throughout the construction process.

Appendix

- Brief Project Schedule
- R.S. Means Square Foot Estimate
- D4Cost2000 Parametric Estimate
- Site Logistics Plan
- Construction Staffing Plan

Brief Project Schedule
The Wilmer Eye Institute Outpatient Sugery & Lab Building

ID	Task Name	Duration	Start	Finish
1	**Major Project Milestones**	**657 days**	**Mon 4/30/07**	**Fri 10/30/09**
2	NTP - Start of Procurement	0 days	Mon 4/30/07	Mon 4/30/07
3	Start of Construction	0 days	Mon 6/11/07	Mon 6/11/07
4	Structure Complete	0 days	Sat 4/19/08	Sat 4/19/08
5	Building Temporary Enclosed	0 days	Wed 8/27/08	Wed 8/27/08
6	Permanent Power	0 days	Thu 9/11/08	Thu 9/11/08
7	Temporary Conditioned Air	0 days	Thu 10/2/08	Thu 10/2/08
8	Conditioned Air Available	0 days	Tue 10/28/08	Tue 10/28/08
9	Building Perm. Weathertight	0 days	Wed 2/25/09	Wed 2/25/09
10	Substantial Completion	0 days	Fri 8/28/09	Fri 8/28/09
11	Project Final Completion	0 days	Fri 10/30/09	Fri 10/30/09
12	**Building Design**	**592 days?**	**Mon 1/9/06**	**Mon 4/14/08**
13	Pre-Design Phase	190 days?	Mon 1/9/06	Fri 9/29/06
14	Schematic Design Phase	77 days?	Mon 8/14/06	Tue 11/28/06
15	Design Development Phase	78 days?	Tue 11/28/06	Thu 3/15/07
16	Structural Design Phase	46 days?	Tue 11/28/06	Tue 1/30/07
17	Contract Documents	101 days?	Thu 3/15/07	Thu 8/2/07
18	Review & Approval	165 days?	Tue 8/8/06	Mon 3/26/07
19	Permit Phases	252 days?	Mon 4/30/07	Mon 4/14/08
20	**Procurement**	**234 days?**	**Mon 4/30/07**	**Wed 3/19/08**
21	Procurement of Major Trades	80 days?	Mon 4/30/07	Fri 8/17/07
22	Procurement of Minor Trades	70 days?	Mon 5/14/07	Fri 8/17/07
23	Submittals (Submit for Approval)	129 days?	Fri 6/8/07	Wed 12/5/07
24	Review & Approval	144 days?	Fri 6/22/07	Wed 1/9/08
25	Fabricate & Deliver	183 days?	Tue 7/10/07	Wed 3/19/08
26	**General Project**	**612 days?**	**Mon 6/11/07**	**Fri 10/9/09**
27	Campus Utilities	302 days?	Sat 3/1/08	Fri 4/24/09
28	General Sitework	300 days?	Mon 6/11/07	Wed 7/30/08
29	Utility Tunnel	117 days?	Wed 8/1/07	Thu 1/10/08
30	Foundations	76 days?	Wed 10/24/07	Wed 2/6/08
31	Building Structure	226 days?	Thu 10/25/07	Tue 9/2/08
32	Building Envelope	196 days?	Wed 6/18/08	Wed 3/18/09
33	Interior & Finishes	130 days?	Wed 4/30/08	Tue 10/28/08
34	Commissioning	540 days?	Wed 9/19/07	Fri 10/9/09



Project: Wilmer Eye Institute

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

R.S. Means Square Foot Estimate

The Wilmer Eye Institute Outpatient Surgery & Laboratory Building

Base Price per Square Foot

	1/4	Median	3/4	Typical Size (GSF)	Size Factor
Hospitals	172	212	310	55000	3.7
Medical Clinics	110	136	172	7200	28.1
Medical Offices	104	128	157	6000	33.7
Research Labs & Facilities	128	184	268	19000	10.7

Cost Multiplier	Location Mult
0.9	92.2

Estimated Building Cost

	1/4	Median	3/4
Hospitals	$28,880,525	$35,596,926	$52,052,109
Medical Clinics	$18,470,103	$22,835,764	$28,880,525
Medical Offices	$17,462,643	$21,492,484	$26,361,875
Research Labs & Facilities	$21,492,484	$30,895,446	$44,999,888

Quick Building Stats:

Size (GSF)	202,350
Location	Baltimore, MD

*All figures referenced from *RS Means Building Construction Cost Data 2008, 66th Annual Edition*

D4Cost 2002 Estimate of Probable Cost

Wilmer Eye Institute - Sep 2007 - MD - Baltimore

Prepared By : Tyler M. Smith

Building Sq. Size : 202350
Site Sq. Size : 70000
Project Height : 80
1st Floor Size : 30000
1st Floor Height : 15
No. Of Buildings : 1
No. Of Floors : 7
Project Type : NEW
Building Use : Medical
Exterior Walls : MAS
Interior Walls : MSD
Foundation : SOF
Roof Type : SPL
Floor Type : CON

Building Costs

Code	Division Name	%	Sq. Cost	Projected
01	General Requirements	3.85	12.40	2,509,621
	General Requirements	3.85	12.40	2,509,621
	Untitled	0.00	0.00	0
03	Concrete	12.61	40.65	8,225,928
	Concrete	12.61	40.65	8,225,928
04	Masonry	0.27	0.87	176,240
	Masonry	0.27	0.87	176,240
05	Metals	6.89	22.20	4,492,735
	Metals	6.89	22.20	4,492,735
06	Wood & Plastics	4.85	15.65	3,167,599
	Wood & Plastics	4.85	15.65	3,167,599
07	Thermal & Moisture Protection	7.81	25.18	5,096,050
	Thermal & Moisture Protection	7.81	25.18	5,096,050
08	Doors & Windows	6.88	22.19	4,490,281
	Doors & Windows	6.88	22.19	4,490,281
09	Finishes	8.39	27.06	5,475,557
	Finishes	8.39	27.06	5,475,557
10	Specialties	0.83	2.69	543,780
	Specialties	0.83	2.69	543,780
11	Equipment	0.47	1.51	306,437
	Equipment	0.47	1.51	306,437
12	Furnishings	0.24	0.79	158,870
	Window Treatment	0.24	0.79	158,870
14	Conveying Systems	3.72	12.00	2,427,316
	Conveying Systems	3.72	12.00	2,427,316
15	Mechanical	24.01	77.42	15,665,142
	Mechanical	24.01	77.42	15,665,142
16	Electrical	19.18	61.85	12,516,098
	Electrical	19.18	61.85	12,516,098
	Total Building Costs	100.00	322.47	65,251,655

Non-Building Costs

Code	Division Name	%	Sq. Cost	Projected
02	Site Work	100.00	52.16	3,651,524
	Landscaping	7.49	3.91	273,649
	Site Work	92.51	48.26	3,377,875
	Total Non-Building Costs	100.00	5216.46	3,651,524
	Total Project Costs			68,903,179

Building Division Notes

Concrete

Concrete, reinforcement.

Metals

Structural framing, decking, fabrications, expansion control.

Wood & Plastics

Finish carpentry, architectural woodwork.

Thermal & Moisture Protection

Waterproofing, insulation, EIFS, fireproofing, GRFC, membrane roofing, roof accessories, skylights.

Doors & Windows

Metal doors & frames, wood & plastic doors, special doors, entrances & storefronts, glazed curtainwall, glazing, hardware.

Finishes

Metal support systems, drywall, tile, acoustical treatment, resilient flooring, carpet, painting.

Specialties

Wall & corner guards, metal lockers, fire extinguishers & cabinets, operable & folding partitions, telephone, toilet & bath accessories.

Equipment

Food service.

Conveying Systems

Elevators (10), pneumatic tube systems.

Mechanical

Mechanical, fire protection.

Non-Building Division Notes

Site Work

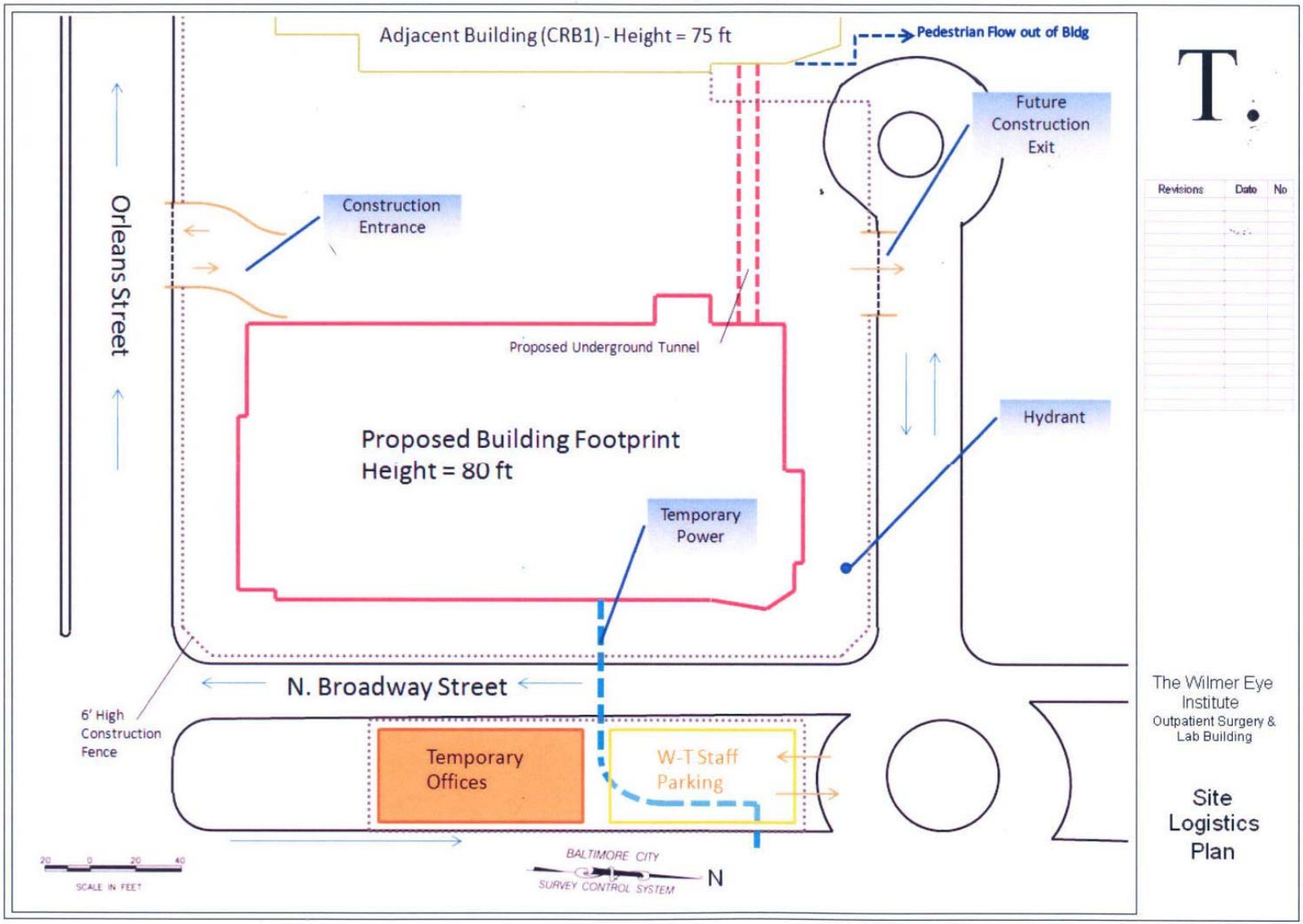
Soil stabilization, earthwork, dewatering, shoring, sanitary sewer & storm drainage, water lines, paving & surfacing, site concrete with gravel base, fences & gates.

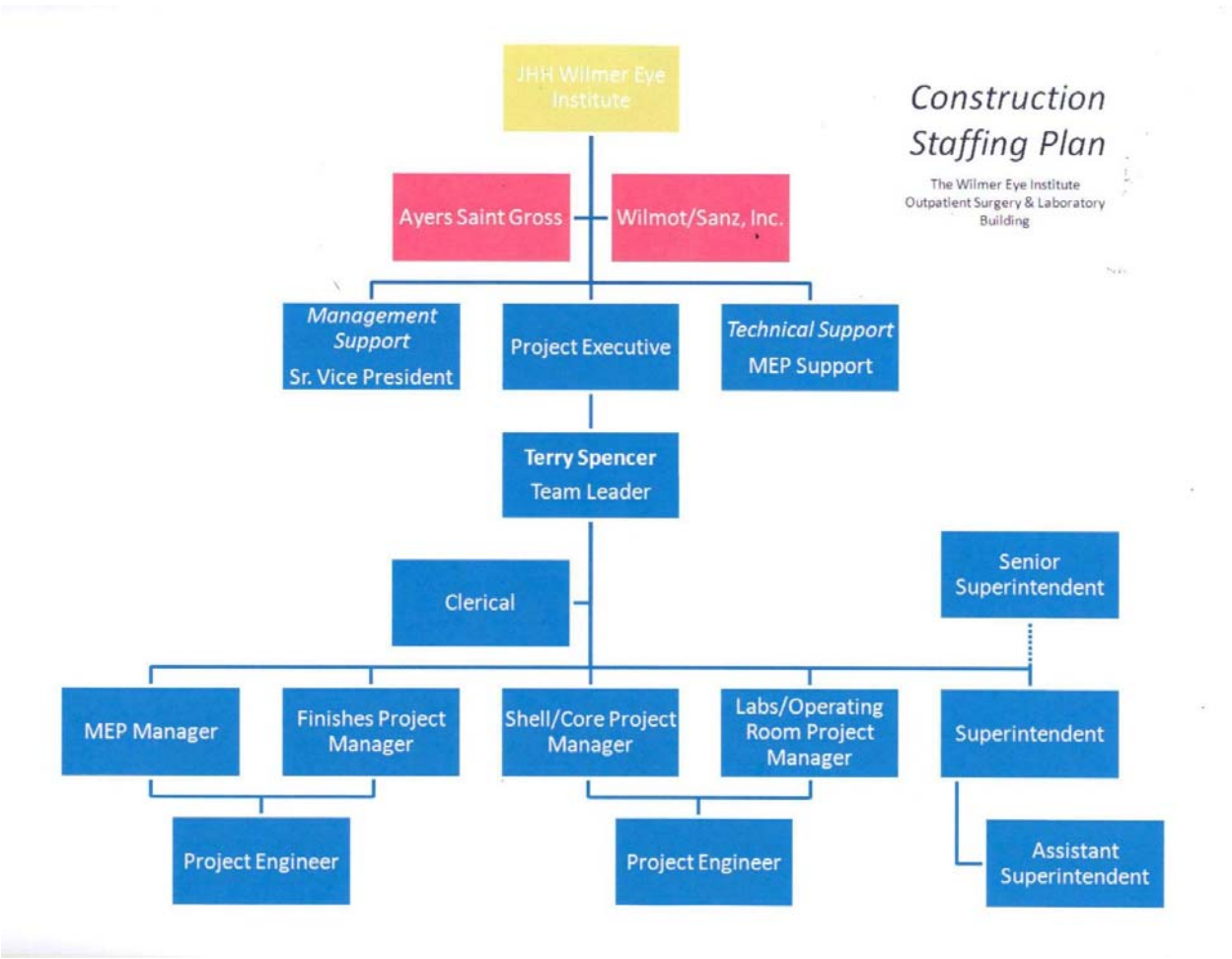
Project Notes

This is a parametric square foot estimate for the Wilmer Eye Institute at Johns Hopkins Hospital in Baltimore, MD.

It was prepared on October 17, 2007.

Estimate Based On Case: MD000514 - Utah Valley Regional Medical Ctr


Adjacent Building (CRB1) - Height = 75 ft
Pedestrian Flow out of Bldg
Future Construction Exit
Construction Entrance
Orleans Street
Proposed Underground Tunnel
Proposed Building Footprint
Height = 80 ft
Hydrant
Temporary Power
N. Broadway Street
6' High Construction Fence
Temporary Offices
W-T Staff Parking
20 0 20 40
SCALE IN FEET
BALTIMORE CITY
SURVEY CONTROL SYSTEM
N
T.
Revisions
Date
No
The Wilmer Eye Institute
Outpatient Surgery & Lab Building
Site Logistics Plan


JHH Wilmer Eye Institute
Construction Staffing Plan
The Wilmer Eye Institute Outpatient Surgery & Laboratory Building
Ayers Saint Gross
Wilmot/Sanz, Inc.
Management Support
Sr. Vice President
Project Executive
Technical Support
MEP Support
Terry Spencer
Team Leader
Clerical
Senior Superintendent
MEP Manager
Finishes Project Manager
Shell/Core Project Manager
Labs/Operating Room Project Manager
Superintendent
Project Engineer
Project Engineer
Assistant Superintendent