City Hospital
Pennsylvania
Phase I

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Executive Summary

This report is intended to familiarize you with the conditions under which the City Hospital Phase I building is constructed and the general overview of the systems incorporated into the building. Phase I is an "L" shaped four-story composite building structure which will provide a research facility, an administrative space, a conference space, and a Central Utility Plant (C.U.P.). Phase II is an 8-floor steel frame building above grade that will be used for research in medicine, and phase III is a proposed 22 floor future expansion of phase II. Once the building is completed to its full capacity, the site will accommodate underground parking, imaging, and an ambulatory building with outpatient care facility, which will be an improved facility for patients, families and employees.

City Hospital is seeking LEED Silver Certification for New Construction. To achieve a silver LEED certification the project must earn between 33- 38 points. Basically, the project complies with all the prerequisites of the credit it intends to apply for. Some of which are, construction activity pollution control, fundamental refrigerant management, the use of a commissioning authority, complying to minimum energy performance standard as set forth by ASHRAE90.1-2004, storage and collection of recyclables on site, the omission of CFC use in the building, the minimization of occupants to environmental tobacco smoke, and complying with minimum indoor air quality.

City Hospital was designed by Ballinger and an engineering design team under a cost plus fee agreement. Turner Construction, the construction manager, provides preconstruction and construction services for the $156 million phased project under a guaranteed maximum price contract. The construction of the 266,000 SF composite building structure has surpassed the current building practices in southern Pennsylvania. For example, the existing site grade was lowered by sixty feet to accommodate the four-story sub grade. The concrete walls are among the highest ever poured in the region. These shear walls were poured in single lifts ranging from forty to seventy-five feet, using the EFCO plate girder system. The research facility will house one of the largest commercial central utility plants in the East Coast. Construction began in March of 2005 with an intended completion date in December 2007.

The following document contains information about the project summary schedule, building systems summary, cost evaluation between RS Means and D4 Cost Estimating methods, a detailed plan of the project site, the project delivery method and a staffing plan.

I. Site Plan of Existing Conditions

The figure on the following page illustrates the site plan of existing conditions for the project at City Hospital. The site is located in south east Pennsylvania. The map shows neighboring buildings, parking locations, temporary facilities, utility lines, access roads, and pedestrian walkways around the site. The owner, City Hospital is located directly north of the project site. Directly to the east is a separate construction site for another research facility. Existing and new utilities are located at the perimeter of the building. The main water and electrical lines are located at the south of the building. The plan provides a better idea of how the project fits into the existing structure of the campus.

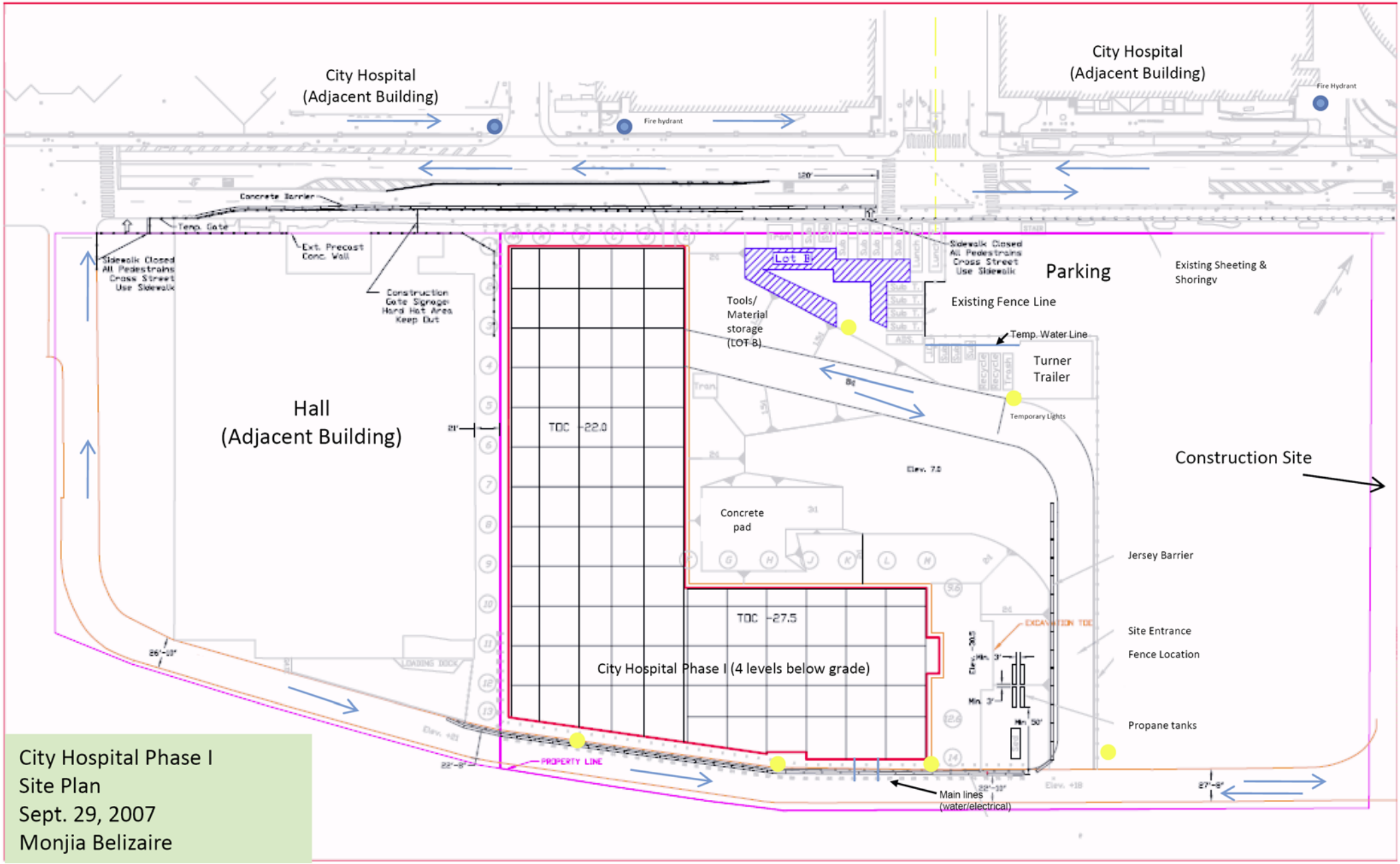


Figure 1.1 Site Plan

II. Building Systems Summary

Construction:

City Hospital holds a lump sum contract with Ballinger Architects to design the structure and the building systems. The project construction is being coordinated by Turner Construction Company and constructed by its prime contractors. Turner acts as a construction manager at risk and holds lump sum contracts with its prime contractors. City Hospital holds a guaranteed maximum price contract with Turner.

City Hospital Phase I is being constructed as part of a three phase construction of the City hospital. Phase I which is the crux of my thesis includes four levels below grade, Phase II is an 8-floor steel frame building above grade. Both Phase I and II will be used for research in medicine. Phase III will be an extension of Phase I and II, it is a planned expansion to add 14 more floors, to make a total of 22 total floor above grade.

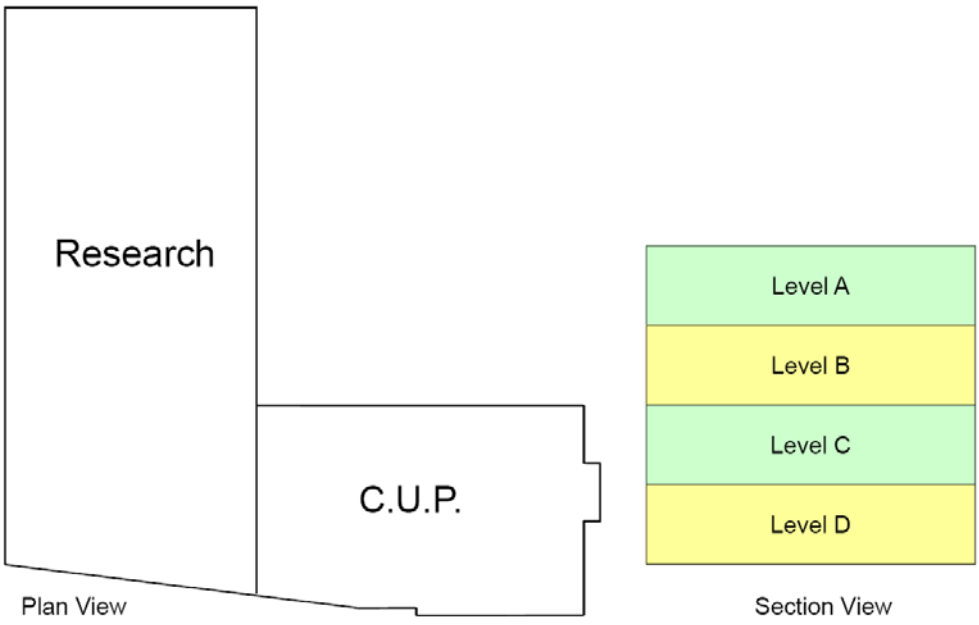


Figure 1.2 Building Plan

Electrical/Lighting:

The building has two services at 13.2 KV located at the south entrance and (2) two megawatt emergency generator for backup power. Power is fed into a medium voltage secondary selective system using three 5000 KVA double ended substations with tie-in. The substations service the electric chiller (2,000 ton), central utility plant, and research facility. Automatic transfer switches are used to divide power into branches of critical, life safety, and equipment in accordance with section 517.30 of the NEC code (2002). Wye-Delta transformers are used to step down the medium voltage supplied to the building utilization voltages of 120V, 208V, 240V, 277V, and 480V as needed.

There are a variety of lighting fixtures used through out the city hospital project, ranging from strip lighting, direct/indirect fixtures, etc. These fixtures use a range of incandescent lamps, compact fluorescents, tubular fluorescents (T-5 and T-8), and HID lamps. Generally, lighting fixtures are mounted in a variety of ways, such as pendants, recessed, or suspended. A couple of specialized lightings, such as operating lights and procedure lights are used to focus a very high intensity of light when carrying out intricate procedures. The offices, research labs and conference rooms use continuous dimming tubular fluorescent ballasts. These types of dimming controls are implemented for the sustainability effect and bid to comply with LEED credit requirement of the project.

Mechanical:

The central utility plant (Levels A through D) houses most of the mechanical equipment. The central cooling towers are located above the A level loading dock. The primary components of the mechanical system include (1) 2,000 ton steam turbine chiller, (1) 2,000 ton electrical chiller, (4) 1,000 ton cooling towers, (4) 800 hp duel fuel boilers, 18 air handling units ranging from 2,500 to 100,000 CFM, and (2) 120,000 cfm exhaust air handling units with heat recovery. The supply air is distributed through industrial air handling units and variable air volume boxes that give occupants the ability to control specific temperature zones from a re-settable set point or by various ventilation motors. This controls help to enhance occupant comfort, and leads to greater productivity. Steam for this facility will be provided from the new CUP. 125 psig; steam shall be reduced in pressure as required and distributed to building heating and research and clinical equipment. The air conditioned source for the new building shall be from a new chilled water plant. The hydronic system will provide building reheat, primary chilled water, secondary chilled water, condenser water, process chilled water, heat recovery / OA glycol water, and future radiation heating.

The building is equipped with a building automation system called direct digital controls (DDC) which enables maintenance and authorized personnel the ability to monitor and control various function of the mechanical equipment. The system also records the performance of the equipment and compares it to expected performance. If there is a major difference (depending on how it is set) a visible/audible alarm is used to signal the conditions.

Structural:

Masonry

The exterior of the research facility consist primarily of a concrete masonry unit (CMU) cavity wall system (4" CMU veneer, 2" air space, 2" rigid insulation, a fluid applied vapor permeable air barrier system, and 8" CMU). The interior partitions are also mainly constructed with 8" CMU; mortar and grout will be used for bonding. The units have an average compressive strength of 1900 psi. The CMU was erected using regular framing scaffold.

Steel Frame

The structural system for the City Hospital uses structural steel columns, wall bracing bays and beams ranging from W12x45 to W24x55. The slab construction consists of 3" deep composite steel deck with 6x6- W4.0x4.0 WWF throughout plus additional reinforcement as required. The steel decking is attached by means of welded shear connectors to the steel beams. A tower crane will be utilized for all steel erection.

Concrete

The foundation consists of cast-in-place concrete spread footings (4,000 psi) with a thick cast-in-place slab on grade. The steel deck carries a 4 ½" normal weight concrete fill. The roof of C.U.P. is constructed by a 4" pour in place concrete over a 5 ½" concrete slab with a waterproofed membrane roof system to accommodate traffic on the loading dock. The 4,000 psi concrete shear walls were formed and poured 72 ft high in one pour. To eliminate the need for internal vibration of the concrete, a ready-mix supplier was used to develop self-consolidating concrete. The steel stairs will require concrete fill-in. The below grade exterior of all precast concrete will be coated with an epoxy coating which is moisture insensitive. Coal tar epoxy will be applied to the exterior precast walls.

Support of Excavation:

The type of support used for excavation for the research facility is a temporary sheeting and shoring technique with rock bolting. Since the spread footing and rock is within the water table, temporary and permanent dewatering was provided. Water pumping is required for deep excavation. A storm water pollution prevention system is being enforced.

Plumbing:

The design for the research facility consists of several components which include sanitary drainage, storm water/roof drainage, foundation drainage, domestic hot water, cold water, and natural gas piping. A 10" domestic water service main enters the building through Level B and drops to a water meter and goes through a reduced pressure backflow preventer. The temperature for the hot water piping which is heated by steam is set at 140°F and runs to plumbing fixtures through out the building. This includes the sinks, water closets, showers, urinals, etc. The re-circulating pumps are used to keep the water in motion so it does not freeze in the pipes. The storm water system roof drains are located above B level research and A level C.U.P loading dock. The main sanitary waste lines leaves through the south end of the building and runs down to an interceptor drain.

Fire Protection:

The building is protected with a wet pipe system, which is complaint with the Americans with Disabilities Act, with recessed flush type sprinkler heads and fire hose standpipe connections. Unheated spaces and the loading docks are protected with a dry pipe sprinkler system. The electrically actuated pre-action sprinkler system protects zoned areas. Each zoned floor is furnished with flow switches, tamper switch, supervised shut off valves, test connections and associated drains in accordance with NFPA 13 and 14.

The preaction system is used in buildings that are susceptible to water damage. There is sensitive equipment like computers and research equipment that has to be protected from unnecessary water in City Hospital. The double interlock preaction system is a system that allows the pipes to be filled with compressed air. When the smoke detector is triggered, the system sounds the alarm and releases the preaction valves; air pressure releases the water out into the previously dry pipes and stays there until a sprinkler head opens. Fire extinguishers will be located throughout the building to put fire out manually.

The fire protection system consist of a an electrically driven horizontal foot mounted, open drip proof, 250HP, 3575 RPM solid state soft start squirrel cage induction motor wound for 480V ac, three phase, 60Hz, fire pump system and a 3HP, 3500RPM three phase 60Hz 480V jockey pump system, and controllers.

Security:

The main security office is located near the south loading dock on "A" level. Some equipment that serves to enhance the security of the entire building are emergency generator annuciators, remote emergency generator start, fire department key box, security panel, and elevator control panel. Door security hardware throughout the building consists of airlock and inter-lock doors, card reader access etc. They are interfaced with security and the fire alarm system. Security cameras are installed at various locations in the building. Elevators and research rooms are also equipped with card readers for access. Security devices and wiring is provided by Carr & Duff and Truefit.

Transportation:

There is provision for eleven standard hydraulic elevators in the hospital. Ten of the elevators are located in the research portion of the building. There are seven elevators being installed as part of phase 1 of the construction project that will service levels A to level D. Only one service elevator will service all the floors in the building (phase 1 and phase 2). There are six stairwells located throughout the building. These stairwells will play a crucial role in evacuation of occupants in the case of an emergency. The major means of egress on each level in research is through two parallel corridors running from north to south. In the C.U.P the major means of egress is a long corridor running from east to west.

Telecommunication:

The telecommunication system includes a raceway support system for all essential low voltage communication wiring provided in the building. The raceway support system shall include rough-in, outlet boxes, conduit, junction boxes, etc. to accommodate various parts of the system. Cabling will be installed for the telephone system, security system (door access, card reader system), data system (CAT 5E/6 copper cabling), and television system. Phones and data jacks are provided in each room. This wiring system installed will ensure the research space runs as a state of the art research facility and provides sufficient communication abilities.

III. Project Schedule Summary

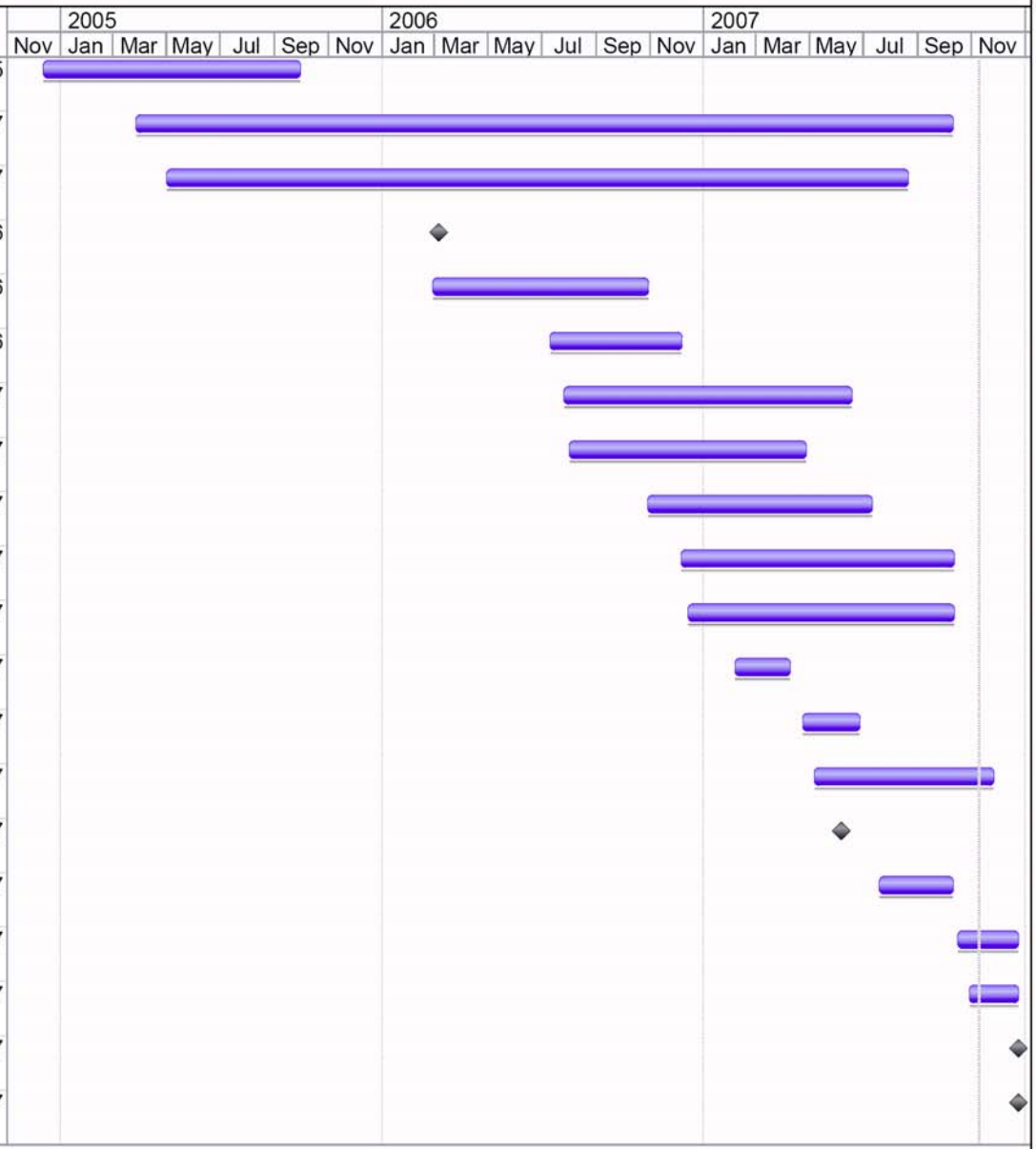
This summary outlines a project schedule that needs to be met in order for this project to be completed on time. Construction is to begin in March of 2005 and set for substantial completion in December 2007.

A separate contract was awarded to Turner for site demolition and excavation. The project includes removal of the existing concrete structure which included a north and south retaining wall. Also, rock bolting, temporary sheeting and shoring were required. The entire sequence of structural items needs to be completed without any major problems that will delay the project. Since this is a 34 month schedule the site work, concrete work, and steel placement needs to be completed as scheduled in order to meet the deadline.

The contract for phase 1 was awarded in June of 2005. The sequenced tasks in the schedule are divided into a C.U.P. and research on the original schedule created by Turner.

City Hospital
Summary Schedule

ID	Task Name	Duration	Start	Finish
1	Design Develpoment	210 days	Mon 12/13/04	Fri 9/30/05
2	Procurement of Services	664 days	Mon 3/28/05	Thu 10/11/07
3	Site work	602 days	Mon 5/2/05	Tue 8/21/07
4	Contract Awarded	1 day	Mon 3/6/06	Mon 3/6/06
5	Foundations	175 days	Tue 2/28/06	Mon 10/30/06
6	Slab on Grade	108 days	Tue 7/11/06	Thu 12/7/06
7	Erect Steel/ Steel Deck	233 days	Thu 7/27/06	Mon 6/18/07
8	Spray on Fire Proofing	193 days	Wed 8/2/06	Fri 4/27/07
9	Waterproofing Foundation Walls	183 days	Mon 10/30/06	Wed 7/11/07
10	Masonry	222 days	Thu 12/7/06	Fri 10/12/07
11	Exterior walls	216 days	Fri 12/15/06	Fri 10/12/07
12	Roofing (CUP)	45 days	Tue 2/6/07	Mon 4/9/07
13	Temporary Roofing (research)	47 days	Tue 4/24/07	Wed 6/27/07
14	Elevators	146 days	Mon 5/7/07	Mon 11/26/07
15	Building Weather Tight	1 day	Wed 6/6/07	Wed 6/6/07
16	Interior Finishes	60 days	Fri 7/20/07	Thu 10/11/07
17	Punchlist	49 days	Wed 10/17/07	Mon 12/24/07
18	MEP Commissioning/ Test and Balance	40 days	Tue 10/30/07	Mon 12/24/07
19	Temp. Cert. of Occupany	1 day	Mon 12/24/07	Mon 12/24/07
20	Substanstial Completion	1 day	Mon 12/24/07	Mon 12/24/07



City Hospital Phase I

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary
Group By Summary
Deadline

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IV. Project Cost Evaluation

The following data is a cost evaluation for City Hospital in Southeast Pennsylvania. Included in this evaluation is building costs, total project costs, and various systems costs such as electrical, HVAC, plumbing, and equipment. Also, there is a square foot estimate comparison using D4 software and R.S. Means pricing.

The square foot estimates for hospitals were taken from R.S. Means Square Foot Estimating Calculator. Additives in this estimate included a location factor of 1.14 for the state of Pennsylvania. D4 Cost estimating software was used to produce a parametric estimate.

Construction Cost: $149 M
Total Project Cost: $156 M
Building Square Foot: 266,000
Construction Cost per square foot: $680/ SF

Building Systems		
Div.	System	Cost
GR	General Requirements	$3,000,000.00
03000	Concrete	$15,234,046.00
04810	Masonry	$5,707,757.00
05000	Steel & Metals	$12,663,863.00
14420	Conveying System	$1,757,799.00
08000	Doors & Windows	$392,243.00
07000	Thermal & Moisture	$4,357,769.00
15400	Plumbing	$5,670,468.00
15300	Fire Protection	$1,952,558.00
15700	HVAC	$20,747,890.00
16000	Electrical	$19,730,101.00
	Total	**$91,214,494.00**

Figure 1.4 Project Cost Data

RSMeans QuickCost Estimator

Project Title:	City Hospital
Model:	Hospital, 2-3 Story
Construction:	Face Brick with Structural Facing Tile / Steel Frame
Location:	PA
Stories:	3
Story Height (l.f.):	12
Floor Area (s.f.):	200,000
Data Release:	2007
Wage Rate:	Union
Basement:	Not included

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

Cost Ranges	Low	Med	High
Total:	$32,993,550	$36,659,500	$45,824,375
Contractor's Overhead & Profit:	$8,248,388	$9,164,875	$11,456,094
Architectural Fees:	$2,089,615	$2,321,795	$2,902,243
Total Building Cost:	**$43,331,553**	**$48,146,170**	**$60,182,712**

Figure 1.5 RS Means Data

2007.1-City Hospital

Divisions | Information | Sources | Comments | User Defined

Target Date and Location: Mar | 2005 | PA - | Building Size: 200,000

Currently Selected: **Concrete**

Div.#	Division/Subdivision	Base Cost	%	Sq. Cost	Projected
01	General Requirem...	3,272,720	2.41	16.23	3,245,448
03	Concrete	6,000,000	4.42	29.75	5,950,000
04	Masonry	3,691,549	2.72	18.30	3,660,786
05	Metals	29,810,937	21.98	147.81	29,562,513
06	Wood & Plastics	231,313	0.17	1.15	229,386
07	Thermal & Moistur...	1,373,037	1.01	6.81	1,361,595
08	Doors & Windows	1,285,272	0.95	6.37	1,274,561
09	Finishes	19,072,707	14.06	94.57	18,913,768
10	Specialties	491,437	0.36	2.44	487,342
11	Equipment	20,410,840	15.05	101.20	20,240,749
12	Furnishings	735,424	0.54	3.65	729,296
13	Special Constructi...	594,245	0.44	2.95	589,293
14	Conveying Systems	2,809,835	2.07	13.93	2,786,420
15	Mechanical	13,564,900	10.00	67.26	13,451,859
16	Electrical	32,277,719	23.80	160.04	32,008,738
	Total Building Cost	135,621,937	100.00	672.46	134,491,754
	Total Project Cost	139,333,585			138,172,472

Figure 1.6 D4 Cost

The D4 cost estimates were unexpectedly dissimilar from the project cost data. D4 is about $13 million dollars under the actual building cost. D4 Cost allows you to modify the estimate so that it matches the building that is being estimated. The RS Means Calculator provided a relatively lower estimate of about $46 million in the high end of construction for hospitals (without fees) compared to the actual. The reason for these estimates being dissimilar is the fact that the calculator did not consider the building being below grade and the building's actual structural system. Also, the building does not include unique architecture features and these types of estimates do not go in depth with the details of the building systems that a particular project may have.

V. Local Conditions

Turner performed site demolition and excavation. Site work included grading, paving, new water, storm and sanitary laterals, new curbs and sidewalks. Due to the hardness of the solid mica schist encountered onsite, excavation required six months of rock blasting. There were a total of forty-two blasts removing 150,000 cubic yards of material. A sheeting and shoring system was used for the support of excavation. An existing north and south retaining wall was removed and replaced with a system capable of supporting the seventy foot open excavation. The new system included soldier piles behind the existing retaining wall. During the early phases of construction, there was a planned destruction of the Hall located to the west of the project site. The Hall was imploded which was a success and pose minimal risk to the surroundings and progress of the City Hospital project. Cast in place structures have been a typical construction practice in the surrounding area. The area is classified as a high density commercial area, mixed-use and residential developments are generally found in the area. There are various area and open space requirements. For example, public spaces must be equal to 30% of the lot and seating and landscaping must be provided.

Turner is responsible for making accommodations for all construction parking on site. There is a designated construction parking to the north of the construction site. To the north of this parking lot is another parking lot that is used by the workers on the adjacent construction site. Construction on the site can be very congested. Before the placement of any cranes, a rigging plan must be approved by Turner. For safety and protection, the south service road would be temporarily closed for delivery access and crane placement. Parking passes are issued to all trades. Since parking is limited on the site, workers are to find their own parking in the area or commute through mass transportation.

This project is going for a LEED rating and all trash and garbage disposal is being provided by an independent waste removal company. There are separate dumpsters for materials such as wood, metal, concrete, paper (office), etc. to provide for onsite separation of recyclables. Turner keeps records and receipt of this transaction, for later submittal to the construction administrator, in their bid to comply with LEED requirements.

VI. Client Information

The owner of this project is City Hospital. City Hospital has a team of professionals which include doctors, facility operators and advisors that direct and communicates the owner's requirements to the engineers responsible. City Hospital is one of the leading research facilities in the world. The research project is part of a second part master plan that will include about eight acres of land located directly across from the Hospital's current clinical and research facilities. Once completed, City Hospital will house a state-of-the-art translational research facility, translating basic science research into real-life treatments and cures, which will include a central utility plant, research space, and underground parking. The project consists of an "L" shaped development that is being constructed in three phases. The owner will award separate contracts for each phase. The total facility development is estimated at $1 billion and could total more than one million square feet which is double the size of the main hospital when complete. The hospital received about $5 M in research support and $6 M overall for patient care services. The hospital plans to renovate another 165,000 square foot. This all signifies that business is good for City hospital.

VII. Project Delivery System

City Hospital is following the format of a construction management at risk system. As seen on the project organizational chart shown in Figure 1.7, the hospital holds a contract with both the architect and the construction manager. Ballinger was selected as the architect by the owner to design the project. The hospital holds a cost plus fee contract with Ballinger. Turner Construction Company (TCCO) was selected as the construction manager and holds a guaranteed maximum price contract with the hospital. Turner was selected based on their past performance with City Hospital through prior work and the working relationship that they have established.

TCCO holds a lump sum contract with each of the subcontractors shown on the organization chart. These subcontractors were selected on the criteria of experience, price and scope of bid. Ballinger does not hold a contract with TCCO, however there is a line of communication between these two companies throughout the term of the project in order to meet the needs of the owner.

Ballinger contracted Bard Rao + Athanas to handle all MEP engineering for the building. They also contracted LeMessurier Consultants to design the structural system for the facility and Pennoni Associates Inc. as civil engineers. All players on this particular project hold lines of communication with each other.

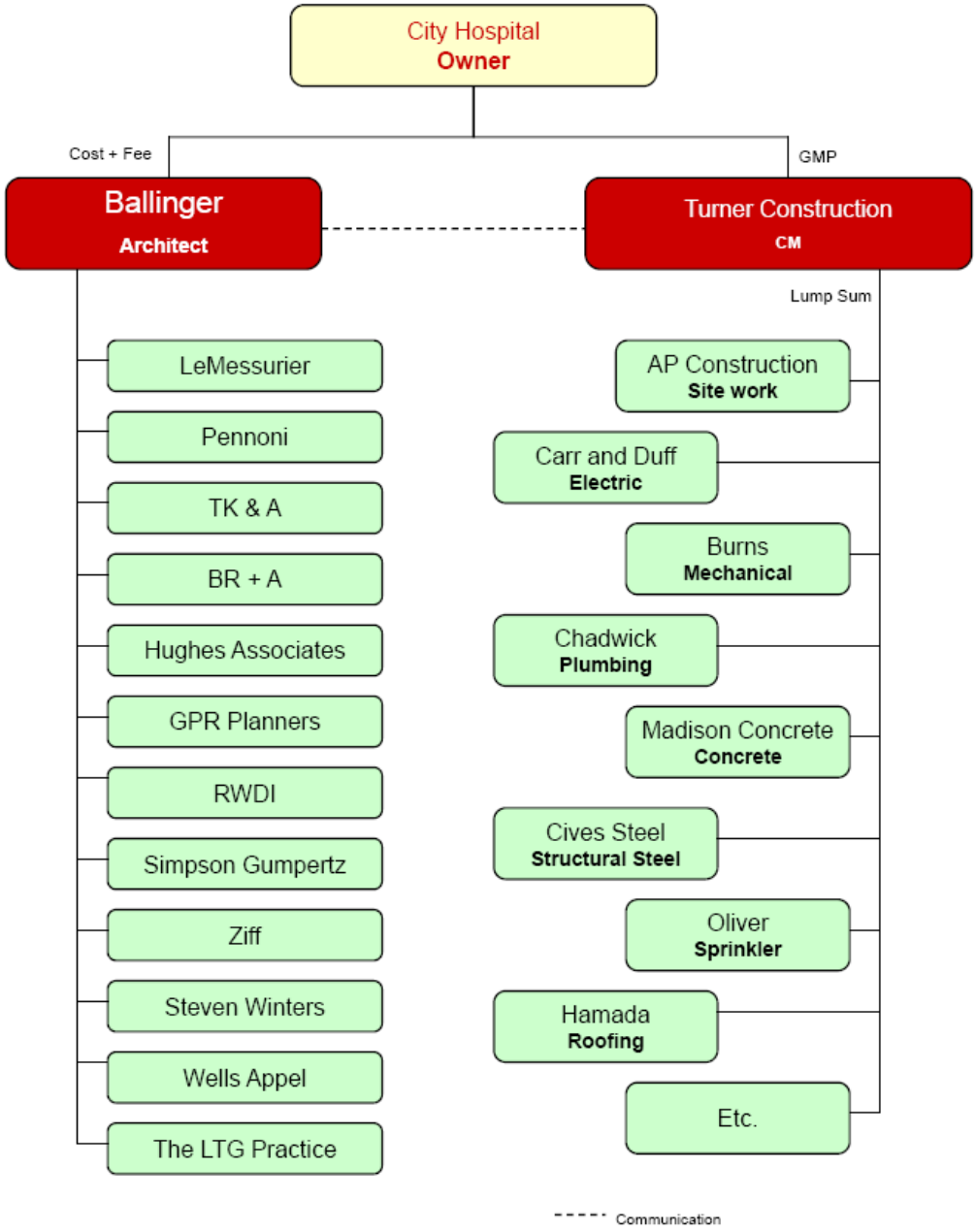

Figure 1.7 Project Organizational Chart

VIII. Staffing Plan

Turner Construction Company has a specific staffing plan for each project. Each project follows the general plan of having a Project Executive, Project Manager, Project Engineers, Accountant, Engineering Administrative, Superintendent, Field Engineers and Carpenters/Laborers assigned to the project. For City Hospital, Turner has formed a very experienced and capable team to ensure this project will be delivered to the quality that the owner expects.

The following chart illustrates the staffing plan at City Hospital.

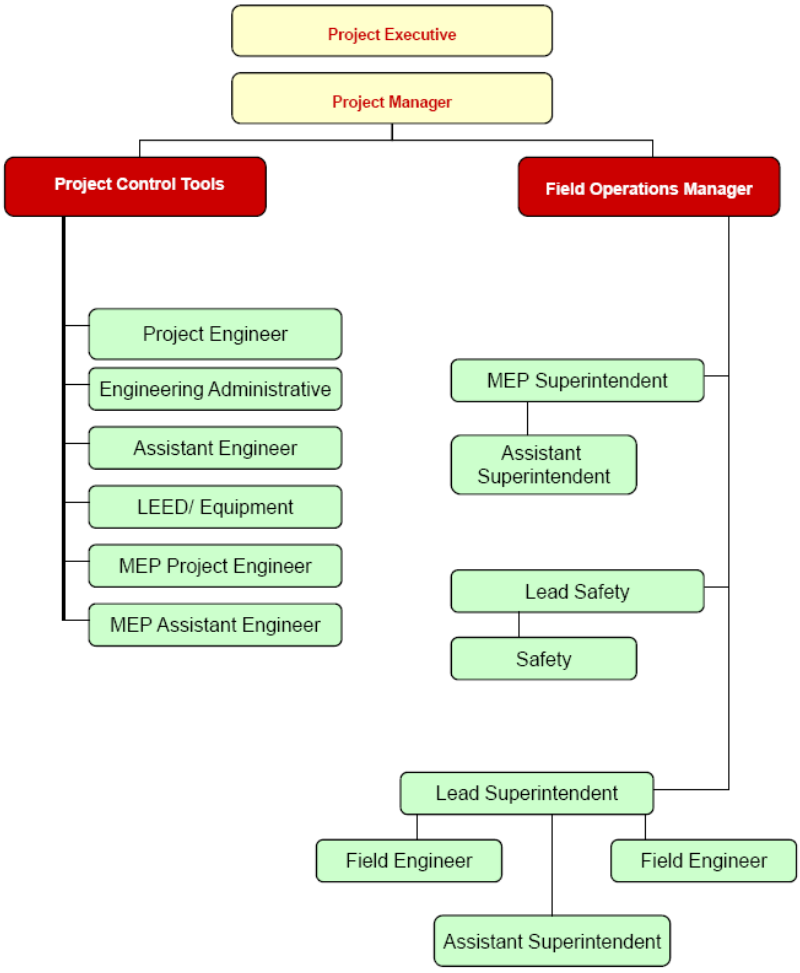

Figure 1.8 Staffing Plan