PENN STATE MILTON S. HERSHEY MEDICAL CENTER
CANCER INSTITUTE

Building Introduction

Project Background

The Penn State Hershey Medical Center (PSHMC) Cancer Institute building is a five-story, 175,000 square facility that will serve as the hospital's center for cancer treatment and research. The project began its early phasing of construction in August 2006, with the full notice to proceed following that November. Design of the building is coordinated with the current Parking Garage and future Children's Hospital projects, with all three employing similar architectural aesthetics such as the curtain wall envelope and granite masonry features. Together these buildings will bring a modernized look to PSHMC's East Campus.

Client Information

The owner entity of this facility is comprised of the Penn State Milton S. Hershey Medical Center and the Penn State College of Medicine. Central to their initiative is to serve the growing central Pennsylvania communities and provide an aging population with the latest technologies dedicated to improving the quality of life. This expansion also comes in response to concerns of a shortage of physicians in the coming years. In 2002, PSHMC developed a 10-year Master Plan for operations and facilities growth. Since its inception, the hospital has seen great progress both in construction and in student numbers. With the recent completion of the Oncology Treatment Building and future plans for the Children's Hospital, PSHMC will continue to thrive as the leading teaching hospital in Central Pennsylvania.

PSHMC's focus for the Cancer Institute project is to minimize the impact on the hospital facilities and to efficiently control expenses during construction. The building will connect to the existing emergency delivery area of the hospital, and thus reconfiguring this critical department requires a keen attention to safety. A comprehensive Infection Control Risk Assessment plan has been developed to ensure patient safety during

renovations and throughout construction of the Cancer Institute. The ICRA plan identifies four risk degree levels based on sensitivity to contamination from construction debris. Areas of the hospital within the assessment zone are assigned on of these risk levels, which then dictates the precautionary measures that must be taken when work is conducted within their vicinity. For the renovation work involved with the Cancer Institute project, a number of hospital areas were categorized as 'High' or 'Highest' risk by the study, including the existing emergency delivery, operating rooms, admissions, endoscopy lab, and dialysis center. It is critical that the necessary steps are taken to ensure patient safety during this early phase of construction.

As significant construction requires large amounts of funding, it is necessary for PSHMC to keep the project under its budget. Current construction of the nearby Parking Garage atop the three treatment facilities equals a costly investment, whose return depends upon buildings meeting their high-quality expectations. Thus, extensive value engineering analyses were performed throughout the design phase of the Cancer Institute to ensure that the quality of the building was maintained as the project cost slowly crept to budget capacity. Also of particular interest for PSHMC was to retain, at a minimum, a LEED Silver rating, which through careful planning has been achieved.

Project Delivery System

The Cancer Institute employs a different delivery method compared to the completed Oncology Treatment Building and the current Parking Garage project. While the OTB and Parking Garage utilized the Gilbane Building Company as construction manager, the Cancer Institute changes Gilbane's role to that of a construction management agency, overseeing a general contractor and its subcontractors. This method enables savings in construction costs while still providing a skilled and knowledgeable management company overseeing work. The contract in place between PSHMC and Gilbane is a cost plus fee arrangement.

PSHMC has used Centerline Associates as its representative and consultant on most of its recent significant construction projects, and will continue to do so with the Cancer

Institute. This entity takes on the role of a project manager above the general contractor, handling all cost negotiations and providing the final word on any sequencing or constructability issues.

The design firms used by PSHMC are compensated using a cost plus fee contract method. The architect on the project, Payette Associates, was an active participant in the Master Plan development project in 2002. Comprehensive designs were proposed and later selected by PSHMC for the expansion plan. Accompanying the Boston-based architecture firm on the project is Array Healthcare Facilities Solutions, acting as associate architects on the project for their experience and regional proximity. Civil and structural engineering responsibilities are handled by Gannett Fleming, while all mechanical, electrical, and plumbing design is performed by Bard, Rao + Athanas, also out of Boston.

Project Schedule Description

A CPM schedule summary is presented at the end of this section, showing key dates and milestones as scheduled by Gilbane Building Company and PSHMC. With two months of site improvements and 26 months of building construction, it is critical for this schedule to be accurate so that any changes or delays can be evaluated efficiently. Impacts to construction have a great effect on daily hospital activities, and thus it is important to identify any pertinent issues early so that the campus can plan for logistical adjustments.

Sequencing Elements

- *Foundation*- After bulk excavation to sub-grade, a 2" mud matt of 2,000 psi to 2,500 psi concrete will be poured over the entire basement floor level, which will be pitched slightly to the perimeter for drainage purposes. The overall structural bearing is placed on load-bearing micropiles that are drilled into the ground approximately 65 feet. The piles require an additional 11 feet of bond length in stable rock to resist uplift and shear forces. When the bond zone has been located, the casing is filled with grout to adhere to the threaded piles. Column

piers and grade beams are formed and placed atop these micropiles. The slab on grade will be poured in sections. First, the 36" slab for the radiotherapy area is poured. At each brachytherapy or linear accelerator unit, the slab is stepped down to provide a shell for the base. After steel erection, the remainder of the 6" slab will be formed and poured.

- *Superstructure*- Steel and metal decking will be installed in bay sections, beginning at the North end of the building and completed one floor at a time. Shear studs for the composite metal deck will be installed prior to the placement of the concrete, and will follow the sequence of the steel member erection. A mobile crane will be used to facilitate this sequence.

- *Finishes*- Interior rough-ins and finishes will follow a typical sequence, beginning with piping, then mechanical, and lastly electrical and light fixture installation. Pipe and mechanical hangers are installed as the metal deck on the floor above is completed, avoiding the need to drill into the composite floor slabs.

Building Systems Summary

Demolition

The first phase of the project includes demolition of a hospital parking lot, the helipad, and a section of the Emergency Delivery area. The existing helipad and ED will be maintained until the new helipad and ED expansion are complete. The ED work demands usage of the Infection Control Risk Assessment plan to ensure that no demolition or construction debris contaminates the existing hospital, threatening patients in surgery and recovery. As the new helipad was constructed adjacent to the existing drop-off, work stoppages were ordered whenever an emergency delivery occurred, typically carrying a 15 to 30 minute notice.

Structural Steel Frame

The superstructure utilizes steel bay construction with mostly moment frame connections. However, central to the structure and found at alternating column lines are three braced

frame systems carried from the first to the fifth floor. Girder and beam sizes vary throughout the structure. Girder sizes typically range between a W18x26 and W27x84 on the first floor, to a W18x65 and W24x76 on the upper floors, all spanning lengths of 31 feet. Beam sizes throughout all floors are predominantly W16's and span from 26 to 29 feet. Columns, meanwhile, fall between a W14x43 and W14x90. Elevated floors are composite concrete slab on metal deck. To assemble the bay sections, one mobile crane will be used, which will run along the East façade of the building beginning at the North end.

Cast-in-Place Concrete

The foundation system uses pile caps and grade beams atop load-bearing foundation micropiles. Grade beams will be poured directly with no forming, though the pile caps will require stick-built forms. Ground floor concrete pours are critical to the project, as the radiotherapy treatment area is found here. A 36" floor slab, depressed at locations for the linear accelerator and brachytherapy units, is coupled with 40" dividing walls and a 60" ceiling, both encased with lead bricks. Placement requires two successive pours and metal formwork to facilitate construction of this critical wall type. Elevated slabs will require the use of a concrete pump for placement.

Mechanical System

The ventilation system for this facility utilizes three central supply air handling units. AHU-C/A-1 is found on the ground floor and services the ground, first, and second floors, and averages 130,000 cubic feet per minute (cfm). The two remaining units, AHU-L-1 and AHU-L-2, are sized at 55,000 cfm, and both provide cooling and heating to the third and fourth floors. These units will provide air to approximately 400 constant volume or variable volume boxes located throughout the building.

Electrical System

Four 15 kV high voltage feeders service the PSHMC, branching off a substation in a centralized location at the back of the campus. The Cancer Institute will run on a 3

phase, 480V / 270V circuit. Emergency backup power will be supplied from a 450 KW, natural gas-powered generator located on the mechanical penthouse.

Project Cost Evaluation

Basic Overall Cost Information

PSHMC	Cost	Cost per Square Foot
Construction Cost	$82,000,000	$468 / sf
Total Project Cost	$96,000,000	$548 / sf

Core Buildings Systems Costs

Building System	Cost	Cost per Square Foot
Structural	$11,520,000	$66 / sf
Mechanical	$9,310,000	$53 / sf
Electrical	$6,350,000	$36 / sf
Plumbing	$4,870,000	$28 / sf

Miscellaneous Systems Costs

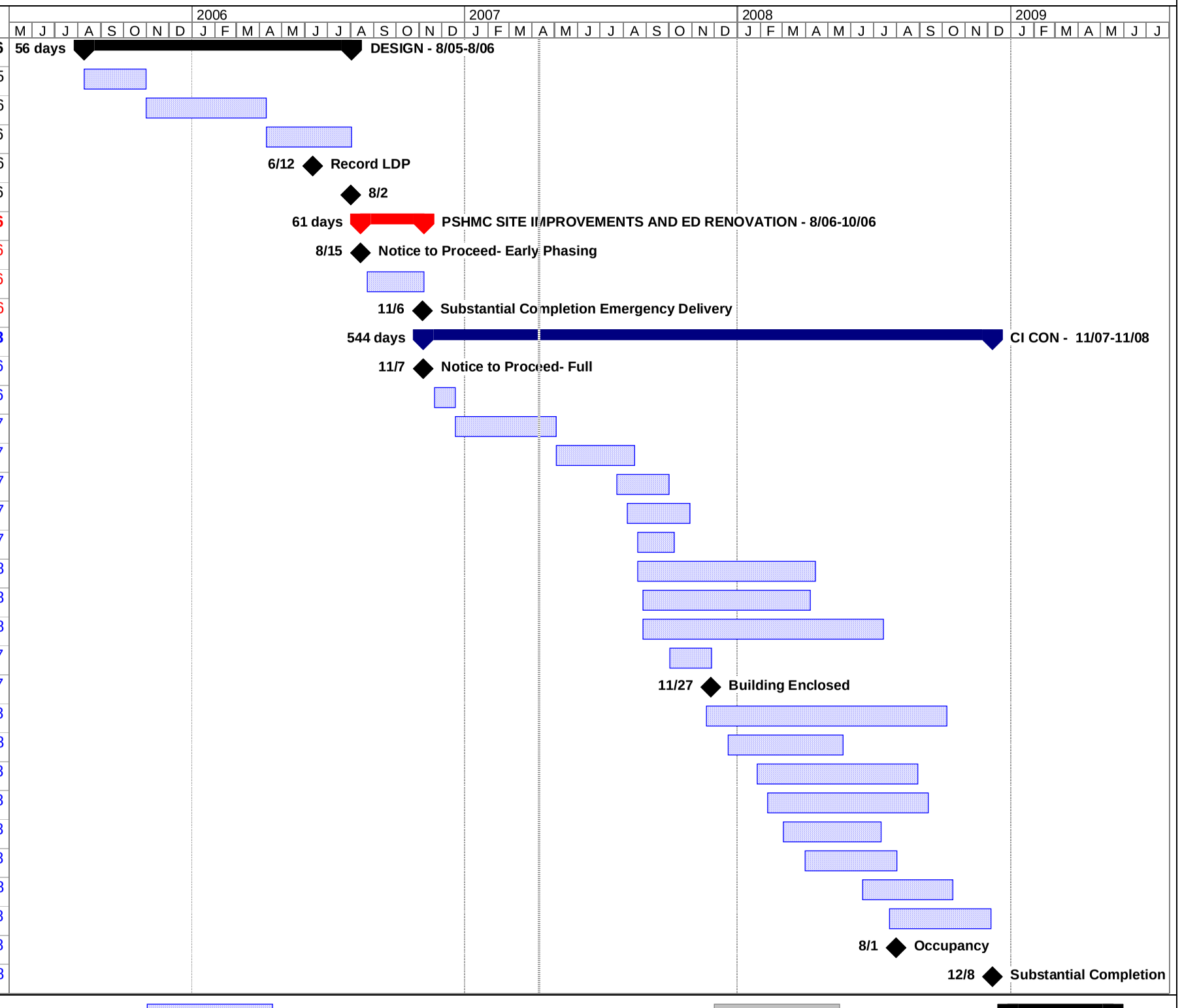
Building System	Cost
Fire Protection	$900,000
Site Work	$7,860,000
Curtain Wall	$5,720,000
Masonry	$90,000
Conveying Systems	$400,000
Building Automation	$1,960,000
Lab Equipment	$850,000

Gilbane

Penn State Milton S. Hershey Medical Center

Cancer Institute Project
Summary Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**DESIGN - 8/05-8/06**	**256 days**	**Wed 8/10/05**	**Wed 8/2/06**
2	Schematic Design	59 days	Wed 8/10/05	Mon 10/31/05
3	Design Development and DD Review	115 days	Tue 11/1/05	Mon 4/10/06
4	Construction Documents	82 days	Tue 4/11/06	Wed 8/2/06
5	Record LDP	0 days	Mon 6/12/06	Mon 6/12/06
6	Complete Construction Documents	0 days	Wed 8/2/06	Wed 8/2/06
7	**PSHMC SITE IMPROVEMENTS AND ED RENOVATION - 8/06-10/0**	**61 days**	**Tue 8/15/06**	**Tue 11/7/06**
8	Notice to Proceed- Early Phasing	0 days	Tue 8/15/06	Tue 8/15/06
9	Early Phasing- Roads/ Utilities/ ED Renovation	54 days	Thu 8/24/06	Tue 11/7/06
10	Substantial Completion Emergency Delivery	0 days	Mon 11/6/06	Mon 11/6/06
11	**CI CON - 11/07-11/08**	**544 days**	**Tue 11/7/06**	**Mon 12/8/08**
12	Notice to Proceed- Full	0 days	Tue 11/7/06	Tue 11/7/06
13	Bulk Excavation	20 days	Wed 11/22/06	Tue 12/19/06
14	Piles / Foundations & Foundation Walls / Underslab Utilities	97 days	Wed 12/20/06	Thu 5/3/07
15	Structural Steel and Decking	75 days	Fri 5/4/07	Thu 8/16/07
16	Concrete Slabs and Linear Accelerator Enclosures	50 days	Tue 7/24/07	Mon 10/1/07
17	Curtain Wall	60 days	Tue 8/7/07	Mon 10/29/07
18	Fireproofing	35 days	Tue 8/21/07	Mon 10/8/07
19	Partition Walls	170 days	Tue 8/21/07	Mon 4/14/08
20	Building Mechanical - Piping	160 days	Tue 8/28/07	Mon 4/7/08
21	HVAC & Start-up MEP Systems	230 days	Tue 8/28/07	Mon 7/14/08
22	Roofing	40 days	Wed 10/3/07	Tue 11/27/07
23	Building Enclosed	0 days	Tue 11/27/07	Tue 11/27/07
24	Electrical	230 days	Wed 11/21/07	Tue 10/7/08
25	Drywall	110 days	Thu 12/20/07	Wed 5/21/08
26	Painting	155 days	Mon 1/28/08	Fri 8/29/08
27	Ceilings	155 days	Mon 2/11/08	Fri 9/12/08
28	Fire Protection	95 days	Mon 3/3/08	Fri 7/11/08
29	Owner FF&E	89 days	Tue 4/1/08	Fri 8/1/08
30	Casework & Flooring	87 days	Tue 6/17/08	Wed 10/15/08
31	Test & Balance	98 days	Wed 7/23/08	Fri 12/5/08
32	Occupancy	0 days	Fri 8/1/08	Fri 8/1/08
33	Substantial Completion	0 days	Mon 12/8/08	Mon 12/8/08



Project: PSHMC Cancer Institute
Date: 10/26/06

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