Monongalia General Hospital

Morgantown, WV

Carmen A. Brutico III

Pennsylvania State University

Architectural Engineering

Construction Management - MAE/BAE

Monongalia General Hospital's Hazel Ruby McQuain Tower

1200 JD Anderson Dr.
Morgantown, WV 26505

Project Team

Owner: Monongalia General Hospital
Architect: FreemanWhite, Inc.
CM: Turner Construction Company
Structural: Atlantic Engineering Service
Civil: Alpha Associates, Inc.
MEP: FreemanWhite, Inc.

Project Overview

- Existing building renovations: 95,000 SF
- Tower Addition: 210,000 SF
- 4 stories above grade, 1 story below grade
- Total Project Cost: $92 million
- Project Delivery Method: Design Build
- Addition of 88 new patient rooms

Structural

- Concrete spread footings supporting cast in place reinforced concrete columns
- First Floor: 5" Slab on grade with 6x6 W.W.F.
- Levels 2-roof: 8" flat slab with drop panels
- 14" cast in place basement(first floor) walls
- Red brick façade with metal stud back-up
- Combination EPDM ballasted roof system & fully adhered roof system

Mechanical and Electrical

- New central utilities plant
- 7-Variable air volume rooftop units
- 2-500 ton, 1500gpm cooling towers
- 2-500 ton water-cooled chillers
- 480V, 5000A Main switchboard
- 2-1500kw backup generators supplied through 1-480V, 8000A switchgear

Carmen A. Brutico III
Construction Management
http://www.engr.psu.edu/ae/thesis/portfolios/2009/cab5001/

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Executive Summary

This report covers the bases of my research for my senior thesis on the Monongalia General Hospital Addition and Renovations Project. The report includes background information about the project including project delivery system, project schedule, project costs, and basic building system information. The report also includes my analyses covering various topics relating to the building project, which are briefly summarized individually.

Analysis 1: ICRA Research and Planning

This analysis involves looking into the Infection Risk Control Assessment process vital to healthcare facilities. To ensure proper measures are taken to reduce infection to patients, research has been conducted my major organizations including the Center for Disease Control, American Institute of Architects, and American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. I look at the work done by these organizations to compile a list of infection control measures for the project.

Analysis 2.1: Owner Assistance

This analysis investigates the problems noticed from previous thesis work about owner inexperience hindering the progress of the project. Interviews with industry professionals attempt to reach a conclusion of whether the project could have benefitted from a owner assistance throughout the project.

Analysis 2.2: Project Delivery

Stemming from the owner assistance analysis, this analysis goes through the process of selecting the proper project delivery system for the project, hoping to shine more light onto the owner related issues and how they can be eliminated. I use a selection tool and project success factors to narrow down project delivery systems to one that fits the needs of the project. The organization of the project teams is also discussed.

Analysis 3.1: Exterior Façade Schedule and Costs

In an attempt to reduce the lengthy exterior enclosures activities durations, I look into an alternative façade system which maintains the red brick aesthetics as desired to match the existing building. The alternate system schedule durations and costs are calculated and compared to the original design.

Analysis 3.2: Exterior Façade Structural

This analysis checks the structural design of the building hoping to find extra savings due the alternate system's lighter load onto the structure. A typical edge beam is examined with full calculations to find the required amount of steel reinforcing in comparison with the original design specifications.

Analysis 3.3: Exterior Façade Thermal

This analysis breaks down the exterior wall assemblies and compares the thermal performance of the walls in the form of total wall r-value.

General Building Data

Building Name: Hazel Ruby McQuain Tower

Location: 1200 JD Anderson Drive
Morgantown, WV. 26505

Building Occupant Name: Monongalia General Hospital

Occupancy or Function Types (type of building): Primary Occupancy: Institutional, I-2
Construction Type: 1-A

Size (square feet): Existing = 205,000
Renovated = 95,000
New = 210,000

Number of Stories Above Grade: Tower Addition - 6 stories / 5 floors

Primary Project Team: Owner: Monongalia General Hospital
Architect: FreemanWhite, Inc.
Construction Manager: Turner Construction Company
Mech. Elec. Plum.: FreemanWhite, Inc.
Structural: Atlantic Engineering Service
Civil: Alpha Associates, Inc.
Interiors: FreemanWhite, Inc.
Fire/Sprinkler: FreemanWhite, Inc.

Dates of Construction: Start of Excavation – June 2006
Completion of Structure – June 2007
Start Renovations – October 2007
Building Closed – December 2007
Start 3rd Floor Renovations – July 2008
Start 2nd Floor West Renovations – August 2008
Start Patient Floor Renovations – August 2008
Construction Complete – October 2009
Project Closeout Complete – December 2009

Cost Information: The current total project cost is at 92 million. The general conditions costs are about 5.5 million, including temporary facilities, safety equipment, general expenses, project staff salaries, and fringes/taxes/insurance.

Project Delivery Method: Design-Build

Architecture Design and Functional Components: The Monongalia General Hospital addition resides south of the existing hospital building and east of the health care center. The addition, named the Hazel Rudy McQuain Tower, rises five floors, one floor shorter than the existing six floor hospital and will have an elevator reaching the sixth floor of the existing building. The tower connects directly to the existing hospital both in the red brick appearance and matching floor levels. The new building also ties into the existing health care center as well as the service tunnel which runs from the existing hospital building to the health care center. In addition, a new central plant building was incorporated to house all the utilities for the new patient tower.

The tower adds 88 new patient rooms for a combined total of 189 beds. The fourth and fifth floors will each have 36 beds divided into sections of nine beds. Each section will include a separate nursing station. All rooms in the existing building will be renovated to become private rooms with handicap accessible restrooms. The new tower will also house the hospital's many departments from administration to radiology.

Building Systems Summary

Cast in Place Concrete

The Hazel Ruby McQuain Tower's structure is primarily cast-in-place concrete. The tower rests on shallow spread footings which support typical sized 24"x24" cast-in-place reinforced concrete columns. The first floor of the tower is partially underground and therefore requires a 14" cast-in-place exterior wall with #4 and #6 size rebars for horizontal and vertical reinforcing. The first floor system is a 5" thick slab-on-grade with 6x6 W.W.F. reinforcing. Floors two through six consist of an 8" thick concrete flat slab system with two-way reinforcing at the top and bottom of the slab, and drop panels at the interior columns. The common beam size is 24"wide x 18"deep, which are located on the exterior of the slabs, large penetrations, and areas of higher loads. The roof structure is the same as the floor systems which support the air handling units. The stair and elevator walls are 12" thick cast-in-place reinforced concrete and act as the structure's shear walls. In addition to the new hospital tower, the new central plant also uses cast-in-place concrete spread footings. The majority of all cast in place concrete was placed using pump trucks. The formwork consisted of a reusable Logik Crane Set Forming System provided by Patent Construction Systems.

Structural Steel

Although the primary structure is concrete, steel members were used in two areas. The new central lobby uses W12x40 columns and a combination of 12"-18" deep wide flange steel beams. The roof system covering the drive up entrance area also uses a combination of wide flange beams and square tube columns. The new central plant incorporates three W10x33 columns to support the added weight of the two cooling towers on the plant's roof. The plant uses a combination of wide flange beams and k-series roof joist for the roofing system. Additional steel beams are used on top of the central plant roof as framing support for the cooling towers.

Mechanical System

To handle the large HVAC loads required in a 210,000 sq. ft. hospital building, a new central plant was built to house most of the mechanical equipment for the new tower. The large HVAC loads require the use of seven variable air volume roof-top units, each sized specifically to the type and sizes of the areas they serve. Located on the roof of the central plant are two 500 ton, 1,500 GPM (gallons per minute) cooling towers, with a reserved spot for a possible future third chiller. Inside the plant, are two 500 ton, 1,500 GPM water-cooled chillers and one 5,175 lb/hr, 100 psi steam boiler. For winter heating the system uses a combination of electric duct heaters and a terminal re-heat system. The building uses a dry-pipe sprinkler system for fire suppression.

Electrical System

In addition to housing the mechanical equipment, the new central plant also holds most of the electrical equipment with three rooms designated specifically for normal power, emergency power, and generators. The normal operating electrical system uses a 480V, 5000A switchboard unit. Backup power is supplied by two 1500 kW generators through a 480V, 8000A switchgear.

Masonry

Most of the masonry on the new tower is on exterior façade consisting of a red brick veneer to match the existing building. Some additional ground faced masonry units are used horizontally around the façade to accent the floor levels. The light brown colored ground faced masonry units are also used as the primary masonry type at specific parts of the building to add to the aesthetics of the building façade. Additionally, concrete masonry units are used throughout the building for a few partition walls. The scaffolding used for the masonry construction was a walk-through pipe scaffolding system.

Curtain Wall

Much of the 2nd and 3rd floors of the new tower contain large curtain wall windows. The northeast stair and elevator lobby use a four story height curved curtain wall, creating an open feel and allowing morning sunlight into light the space. The southeast corner has a full curtain wall as well, spanning two stories from the 2nd to 3rd floors. Five large curtain wall windows open the southern part of the 3rd floor to sunlight and a beautiful view. The dark pained glazing adds a modern look to the simple red brick exterior façade. The curtain wall system uses 7" aluminum framing and two types of glass. The 1" clear insulated tempered glass is used from floor to ceiling, while a similar 1" insulated tempered spandrel glass is used in areas to conceal the structure behind while continuing with the glazing from floor to floor.

Support of Excavation

The new Hazel Ruby McQuain Tower sits directly adjacent to the existing hospital building. With the new tower's foundations being so close to the foundations of the existing building, the excavation process required a soil nailing support system. The systems consisted of three, 5' lifts made of 4" thick shotcrete with 2 layers of wire-mesh reinforcing. Each 5' section uses #10 size bars tensioned to 150 kips. The excavation and soil nailing process required 6-7 days in between lifts in order to insure proper curing time for the shotcrete retaining wall. Most of the soil nailing walls were only temporarily installed and removed upon completion of the new tower's foundation. In some locations the soil nailing remained permanent, in which the bars were epoxy coated for corrosion protection. In these areas, gravel was placed in between the retention wall and foundation wall to enable water drainage.

Project Delivery System

The delivery method for this project is unique in that it is defined as a design-build delivery method but essentially utilized a competitive bidding process to select the construction manager, instead of the usual design-build or joint venture firms. The project began as the owner brought an architect (FreemanWhite) on board early in the design phase to then plan and design the project. The architect holds a Guaranteed Max Price (GMP) contract with the owner. The at-risk construction manager (Turner) for the project also holds a GMP contract but with the architect and not with the owner (Monongalia General Hospital), as in most cases. This is also where the combination of delivery methods comes in to play. The selection for the CM on the project was declared using 70% document completion, justifying a design-build delivery. The construction team was permitted to break ground under contract of the 70% complete documents. As mentioned, the selection of the CM was done through a competitive bidding process often used in design-bid-build delivery methods, making the delivery method on this project a unique combination of delivery methods.

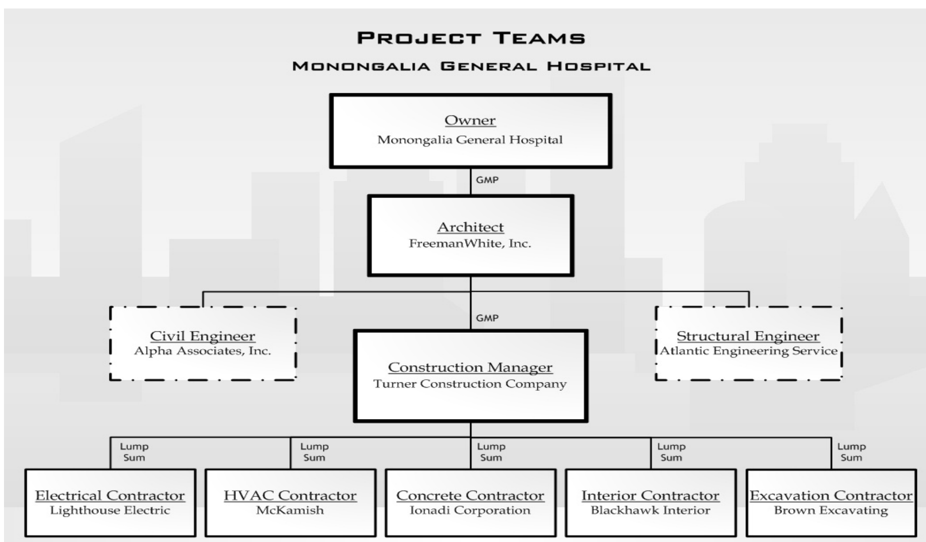


Figure 1 - Project Delivery Team Organizational Chart

The architect performed most of the design elements such as architecture, MEP, interiors, and fire and sprinklers. The structural and civil design work, were contracted out by the architect, to third parties engineering companies. The two firms are illustrated on Figure 1 with their contracts most likely being lump sums.

The CM holds all the contracts with the performing construction companies. The five major subcontractors are shown in Figure 1. All of the subcontractors hold lump sum contracts with the CM. The requirement for subcontractor selection was a minimum of three bidders per scope package. Each of the subcontractors was required to provide their own performance bond and insurance. Additionally the CM held its own general liability insurance.

Construction Manager Staffing Plan

The Turner construction team on the Monongalia General Hospital Project is split into a field team and an engineering team, both of which are located onsite. Also onsite is a field secretary. The secretary manages the site office on both the field and engineering side. The engineering team is led by a project engineer who has an additional assistant project engineer positioned below him to assist in the field engineering duties. The field team is made up of two superintendents and four field engineers. The construction supervision consists of a full time field superintendent and an MEP superintendent. The addition of the MEP superintendent was essential to handling the additional field coordination due to the hospital's intricate MEP systems. One of the four field engineers was designated as a safety engineer to handle all the safety items on the project. Directly overseeing the entire project is the project manager, who reports to the project executive. Topping out the administrative personnel is an operations manager positioned above the project executive. Additional to the field personnel, a cost engineer located offsite in a regional office is designated to handle project cost information.

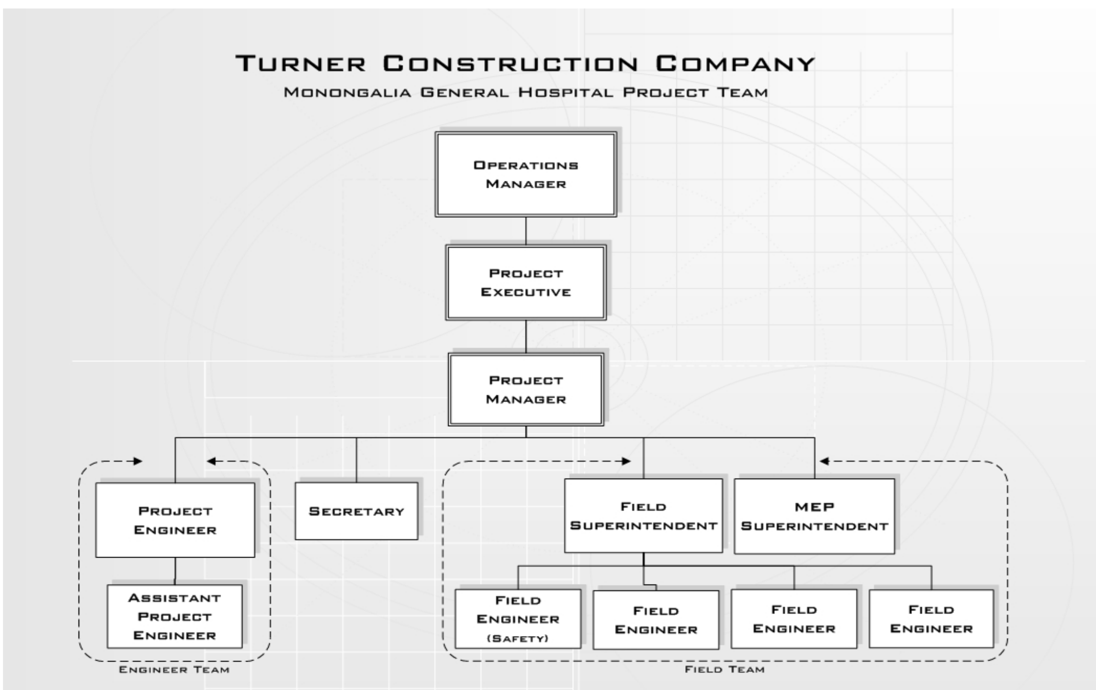


Figure 2 - Project Delivery Team Organizational Chart

Site Layout

A hospital site plan requires special attention due to the sensitivity of health care providing and emergency planning. Construction activities on and around a functioning hospital have to be carefully planned to prevent interferences with the round the clock operations of the hospital. Collaboration with hospital officials is needed to arrange the construction site in such a way as to not block any of the major entrances for emergency personnel. Since a construction site is constantly changing according to the phase of the construction, a dynamic site layout according to the construction phase is often needed to cooperate with both the changing construction activities and the workings of the hospital.

The Monongalia General Hospital project is fortunately located in fairly open area. The site size does not constrict the construction zones, but rather easily provides the necessary space to construct the building without much trouble. The one area which does pose some consideration is the Health Care Center located in the southwest corner of the site. This limits access to the southwestern corner of the new tower. The southwest parking lot near the Health Care Center was left open for public parking and access to the Center. The south entrance from JD Anderson Drive, into the east parking lot, received changes to redirect traffic around the construction zone. Most of the parking lot and entrance road changes were left in place to later connect to the new tower's entrance canopy outside of the new main lobby.

Figure 3 - Arial photo of the existing Monongalia General Hospital

The site phase chosen to layout is the exterior enclosures and façade. The exterior façade is a red brick veneer with metal stud backing, to match the existing building. Curtain wall systems were also used often spanning two or more stories to accent the design with a more modern look. Traditional pipe scaffolding was used to construct the brick masonry façade.

The site plan of existing conditions developed in Tech Reports I is very similar to the site layout developed for the exterior enclosures and façade, and therefore is provided again as an excellent guide.

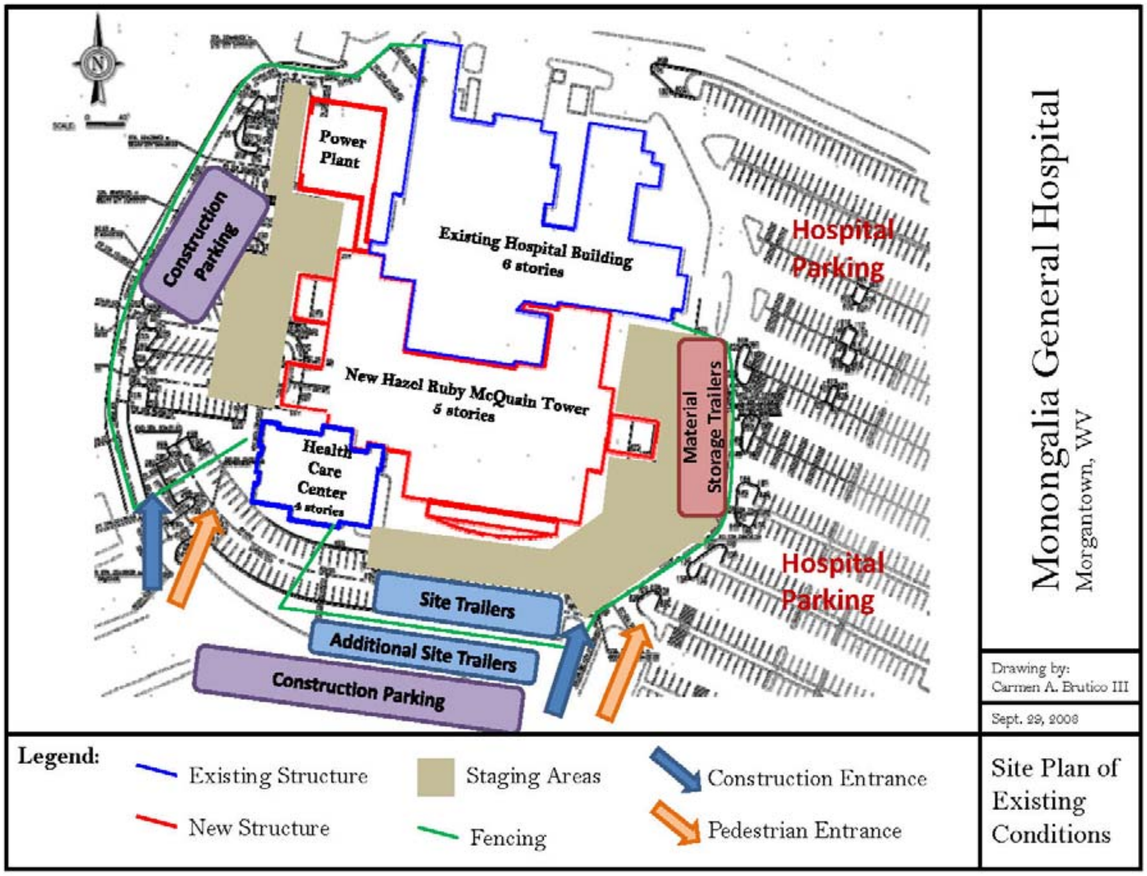


Figure 4 – Site plan of existing conditions

Three site layout plans for the exterior enclosures and façade are located in Appendix B. Two of the three are 3-D views of the site with labeling of important site items. The third is a plan view also labeled, clearly indicating the locations of key areas and items. Additional 3-D site views are provided below to better visualize and understand the site layout.

Figure 5 – View of Southeast corner

Figure 6 – View from the Southeast

Figure 7 – View from the Northeast

Detailed Project Schedule

Zones

Construction sequencing on the project proceeds in order from one zone to the next. As one zone is complete with the activity it starts the next activity on the schedule. The next zone then begins with the previous zone's completed activity, and so on and so forth, throughout the majority of the main construction phases. There are three construction zones. The main tower is divided in half making up two of the three zones. The central plant is the third zone. This zone sequencing allows for activities and crews to work in a smaller area then if they were to work on the entire building until it was complete. This helps to relieve congestion on the site and within the building between contractors, and in turn speeds up the construction process.

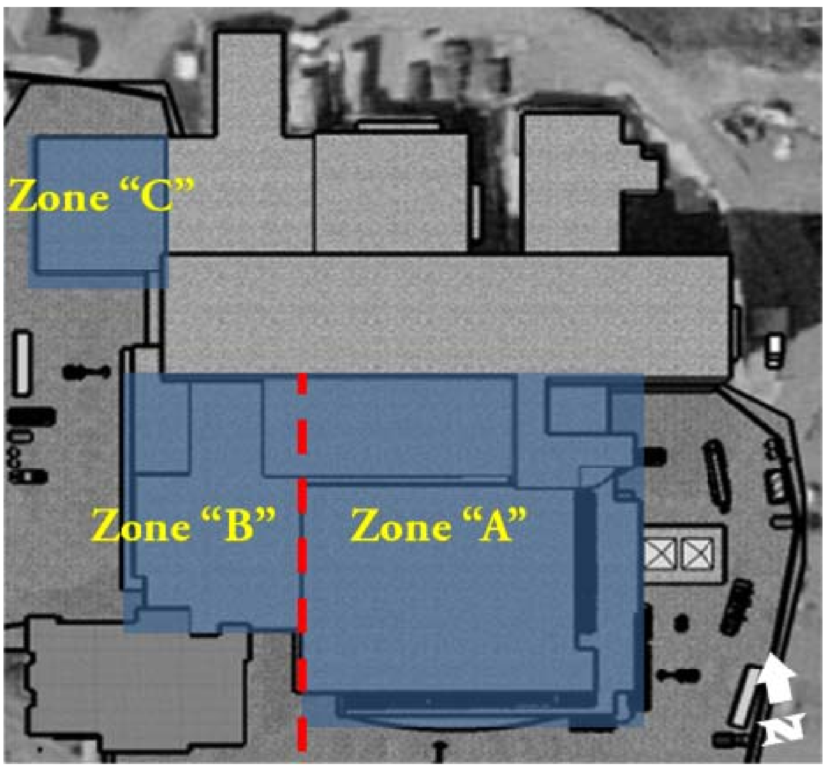


Figure 8 – Plan view showing the construction zones

The division of the building into sequencing zones definitely aids in the factors mentioned, but the overall form and layout of the building doesn't allow for perfect sequencing. The building does not have a continuous shape or repetition in the construction of the different zones. In addition, the zones are not even equal in size (SF) and have different uses. The main zone "A" is the bulk for the tower, with the largest area and the most floors. Zone "C" is the central plant which is essentially a separate little building tied into the others. Zone "B" is the west area of the new tower. The three zones are shown in Figure 8.

Exterior Enclosures

The exterior enclosure and façade construction is not broken up into the zones but into the four sides of the building. The sequencing progresses from the north elevation in a clockwise rotation around the exterior in three major parts with the following order: studs and Dow board, exterior masonry, and curtain wall and windows.

Renovations

After completion of the new Hazel Ruby McQuain Tower, Monongalia General Hospital moved right in and construction progressed on to the renovations inside the existing hospital building. The renovations in the existing building take place in the main tower. They consist of multiple health care departments and patient rooms from floors one to six.

Figure 9 – Plan view showing renovations on the existing hospital building

Additional Schedule Statistics

	Months	Work-days[1]	Work-hours[2]
Addition	25	525	4,200
Renovations	15	315	2,520
Total	40	840	6,720

Figure 10 – Schedule Statistics

[1] assumes 21 workdays per month
[2] assumes 8 hours per day

Project Cost Evaluation

- Addition Size: 210,000 SF
- Renovation Size: 95,000 SF
- Total Construction Size: 305,000 SF

CSI Divisions		Total Project Costs ($)	Total Construction Costs ($)	Costs/Square Foot ($)
Division 1	General Requirements	628,200	~	2.06
Division 2	Site Construction	5,072,862	~	16.63
Division 3	Concrete	7,833,806	7,833,806	25.68
Division 4	Masonry	1,590,515	1,590,515	5.21
Division 5	Metals	1,905,170	1,905,170	6.25
Division 6	Wood and Plastics	2,379,075	2,379,075	7.80
Division 7	Thermal and Moisture Protection	837,000	837,000	2.74
Division 8	Doors and Windows	2,168,575	2,168,575	7.11
Division 9	Finishes	8,927,785	8,927,785	29.27
Division 10	Specialties	75,600	75,600	0.25
Division 11	Equipment	65,444	65,444	0.21
Division 12	Furnishings	0	0	0.00
Division 13	Special Construction	0	0	0.00
Division 14	Conveying Systems	1,428,115	1,428,115	4.68
Division 15	Mechanical	14,753,595	14,753,595	48.37
Division 16	Electrical	9,425,035	9,425,035	30.90
	Totals	57,090,777	51,389,715	
	Cost/SF	187.18	168.49	

Table 11 – Project Cost Breakdown

Actual Construction Costs

- Construction Cost (CC): $ 51,389,715
- Construction Cost per Square Foot: $ 168.49 / SF

Total Project Costs

- Total Project Cost (TC): $ 57,090,777
- Total Project Cost per Square Foot: $ 187.18 / SF

Detailed Structural Estimate

The structural system for the new Hazel Ruby McQuain Tower is primarily cast in place concrete with steel rebar reinforcing. The tower rests on shallow spread footings which support typical sized 24"x24" columns. The first floor of the tower is partially underground and therefore requires a 14" cast-in-place exterior wall with #4 and #6 size rebars for horizontal and vertical reinforcing. The first floor system is a 5" thick slab-on-grade with 6x6 W.W.F. reinforcing. Floors two through six consist of an 8" thick concrete flat slab system with two-way reinforcing at the top and bottom of the slab, and drop panels at the interior columns. The common beam size is 24"x18" (width x depth), which are located on the exterior of the slabs, large penetrations, and areas of higher loads. The roof structure is the same as the floor systems which support the air handling units. The stair and elevator walls are 12" thick cast-in-place reinforced concrete and act as the structure's shear walls. In addition to the new hospital tower, the new central plant also uses cast-in-place concrete spread footings.

The placement method for the concrete is by pump truck. The concrete formwork consisted of a reusable Logik Crane Set Forming System provided by Patent Construction Systems. In the estimate provided, I used the costs associated with the closest formwork system to the actual formwork used.

Although the primary structure is concrete, steel members were used in two areas. The new drop off area in front of the main lobby uses a multitude of small wide flange steel beams to support the entrance roof. The new central plant incorporates three W10x33 columns to support the added weight of the two cooling towers on the plant's roof. The plant uses a combination of W-flange beams and K-series open web joist for the roofing system.

The structural system estimate incorporates the entire cast in place reinforced concrete structure and the structure steel members. The primary resource for the estimate costs were taken from R. S. Means 2008. Some rebar reinforcing was taken off by using a square foot approximation method by estimating the amount of rebar in one square foot of the area (floor, wall, etc.) and then multiplying by the total area. Most of the concrete quantities were personally obtained by take-offs directly from the construction documents. Two summary estimates are provided as well as a few sample quantity take-offs for referencing. Figure 12 is the detailed estimate broken down by divisions. Figure 13 is also the detailed estimate broken down by structure type.

The estimate total added up to be $ 4,266,794.13. This cost is 6.6% of the total construction cost. That percentage is low primarily because the total construction cost includes the costs for the 95,000 SF of renovations. The estimated new area of occupied space in the addition is 210,000 SF, bringing the estimated structure cost to be $20.32/SF.

- **Total Structural Estimate = $ 4,266,794.13**
- Percentage of the Total Construction Cost = 6.6%
- Structure Cost Per Square Foot = $ 20.32

Structural System Estimate By Division							
CSI Code	Description	Quantity	Unit	Material Cost	Labor Cost	Equipment Cost	Total Cost
03300	**Concrete**						
	3000 psi	1091.08	CY	101			$ 110,199.08
	4000 psi	982.1	CY	106			$ 104,102.60
	5000 psi	7859.81	CY	111			$ 872,438.91
	Total						**$ 1,086,740.59**
03050	**Placement**						
	Foundations	1091.08	CY		14.45	5.25	$ 21,494.28
	Walls	1600.77	CY		19.75	7.20	$ 43,140.75
	Columns	630.22	CY		23.50	8.60	$ 20,230.06
	Elevated Slabs	5290.86	CY		13.55	4.94	$ 97,828.00
	Beams	337.96	CY		36.00	13.50	$ 16,729.02
	Slab on Grade	982.1	CY		16.70	6.10	$ 22,391.88
	Total						**$ 221,813.99**
03200	**Reinforcing (in place)**						
	Foundations	29.03	tons	890.00	655.00		$ 44,851.35
	Walls	41.04	tons	890.00	460.00		$ 55,404.00
	Columns	52.13	tons	935.00	915.00		$ 96,440.50
	Elevated Slabs	1230	tons	990.00	475.00		$ 1,801,950.00
	Beams	38.68	tons	935.00	860.00		$ 69,430.60
	Slab on Grade	636.4	CSF	26.50	23.00		$ 31,501.80
	Total						**$ 2,099,578.25**
03110	**Forming (in place)**						
	Spread Foundations	3928.85	SFCA	1.20	3.27		$ 17,561.96
	Strip Foundations	1892	SFCA	4.10	2.75		$ 12,960.20
	Walls	39897	SFCA	0.83	4.15		$ 198,687.06
	Columns	8508	SFCA	1.67	2.75		$ 37,605.36
	Elevated Slabs	49689	SF	1.55	3.43		$ 247,451.22
	Beams	10038	SFCA	0.90	4.73		$ 56,513.94
	Slab on Grade	252	LF	0.38	2.02		$ 604.80
	Total						**$ 571,384.54**
03050	**Finishing**						
	Floor Slab Finishing	262395	SF		0.68		$ 178,428.60
	Total						**$ 178,428.60**
05000	**Structural Steel**						
05120	Wide Flange Members		total				$ 98,413.75
05210	Open Web Joists		total				$ 10,434.41
	Total						**$ 108,848.16**
	TOTAL						**$ 4,266,794.13**

Figure 12 – Structural System Estimate Broken Down By Division

Structural System Estimate						
Description	Quantity	Unit	Material Cost	Labor Cost	Equipment Cost	Total Cost
Column Foundations						
3000 psi concrete	721.45	CY	101.00			$ 72,866.45
Placement	721.45	CY		14.45	5.25	$ 14,212.57
Steel Reinforcing (in place)	20.33	tons	890.00	655.00		$ 31,409.85
Forming (in place)	3568.25	SFCA	1.20	3.27		$ 15,950.08
TOTAL						**$ 134,438.94**
Strip Foundations						
3000 psi concrete	243.56	CY	101.00			$ 24,599.56
Placement	243.56	CY		14.45	5.25	$ 4,798.13
Steel Reinforcing (in place)	4.61	tons	890.00	655.00		$ 7,122.45
Forming (in place)	1892	SFCA	4.10	2.75		$ 12,960.20
TOTAL						**$ 49,480.34**
Spread Foundations						
3000 psi concrete	126.07	CY	101.00			$ 12,733.07
Placement	126.07	CY		14.45	5.25	$ 2,483.58
Steel Reinforcing (in place)	4.09	tons	890.00	655.00		$ 6,319.05
Forming (in place)	360.6	SFCA	1.20	3.27		$ 1,611.88
TOTAL						**$ 23,147.58**
Shear Walls						
5000 psi concrete	744.33	CY	111.00			$ 82,620.63
Placement	744.33	CY		19.75	7.20	$ 20,059.69
Steel Reinforcing (in place)	13.42	tons	890.00	460.00		$ 18,117.00
Forming (in place)	20097	SFCA	0.83	4.15		$ 100,083.06
TOTAL						**$ 220,880.38**
Elevated Floor Slabs						
5000 psi concrete	5290.86	CY	111.00			$ 587,285.46
Placement	5290.86	CY		13.55	4.94	$ 97,828.00
Steel Reinforcing (in place)	1230	tons	990.00	475.00		$ 1,801,950.00
Forming (in place)	49689	SF	1.55	3.43		$ 247,451.22
Slab Finishing	198755	SF		0.68		$ 135,153.40
TOTAL						**$ 2,869,668.08**
Columns						
5000 psi concrete	630.22	CY	111.00			$ 69,954.42
Placement	630.22	CY		23.50	8.60	$ 20,230.06
Steel Reinforcing (in place)	52.13	tons	935.00	915.00		$ 96,440.50
Forming (in place)	8508	SFCA	1.67	2.75		$ 37,605.36
TOTAL						**$ 224,230.34**
Basement Walls						
5000 psi concrete	856.44	CY	111.00			$ 95,064.84
Placement	856.44	CY		19.75	7.20	$ 23,081.06
Steel Reinforcing (in place)	27.62	tons	890.00	460.00		$ 37,287.00
Forming (in place)	19800	SFCA	0.83	4.15		$ 98,604.00
TOTAL						**$ 254,036.90**
Slab on Grade						
4000 psi concrete	982.1	CY	106.00			$ 104,102.60
Placement	982.1	CY		16.70	6.10	$ 22,391.88
Steel Reinforcing (in place)	636.4	CSF	26.50	23.00		$ 31,501.80
Forming (in place)	252	LF	0.38	2.02		$ 604.80
Slab Finishing	63640	SF		0.68		$ 43,275.20
TOTAL						**$ 201,876.28**
Beams						
5000 psi concrete	337.96	CY	111.00			$ 37,513.56
Placement	337.96	CY		36.00	13.50	$ 16,729.02
Steel Reinforcing (in place)	38.68	tons	935.00	860.00		$ 69,430.60
Forming (in place)	10038	SFCA	0.90	4.73		$ 56,513.94
TOTAL						**$ 180,187.12**
Structural Steel						
Wide Flange Members		total				$ 98,413.75
Open Web Joists		total				$ 10,434.41
TOTAL						**$ 108,848.16**
TOTAL						**$ 4,266,794.13**

Figure 13 – Structural System Estimate Broken Down By Assembly

General Conditions Estimate

A general conditions estimate was developed for the project. Project staffing is relative to the actual job staffing as per the staffing organizational chart provided below in Figure 14 for reference. A few additional assistance personnel located in regional offices not shown in the organizational chart were also charged to the job for the slight amount of contribution and time spent on the project. Most of the cost units were taken from R.S. Means 2007 and 2008. Examination of the project and construction site location aided in determining the necessary items to include in the estimate. The construction duration of 42 months was used to calculate the time dependent costs.

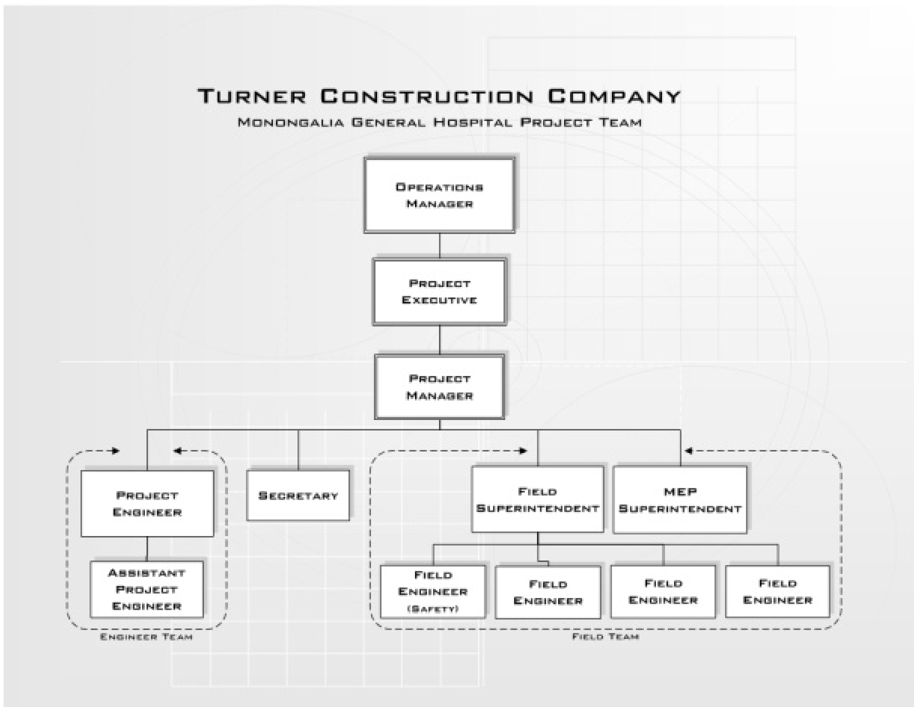


Figure 14 – Project Staffing Organizational Chart

The staffing calculations are broken down by using main project phases in order to accurately estimate the amount of time to charge each personnel to the job. Each personnel contribute a different amount in each of the project phases. The amount designated to each phase is then weighted by the length of the phase relative to the total length of the project. Figure 15 better demonstrates this by charting the phase lengths and percentages.

	MONTHS	% OF PROJECT TOTAL
PRE-CONSTRUCTION PHASE	6	13%
ADDITION CONSTRUCTION PHASE	24	50%
RENOVATION CONSTRUCTION PHASE	18	38%
PROJECT TOTAL	48	

Figure 15 – Project Phase Durations

Because not all of the personnel are working exclusively on this project at a certain phase, this breakdown method is used to more easily calculate the resulting amount of time each individual will be working on the project. Figure 16 shows the administrative personnel and their contributions on this project. These contributions and the percentages of each phase with respect to the total project duration are used to obtain the total percent the individual is working on the project. The resulting weeks for each are then calculated and used directly in the general conditions estimate.

PROJECT STAFF	% ON PRE-CON	% ON ADDITION	% ON RENOVATION	TOTAL % ON JOB	RESULTING WEEKS
PROJECT MANAGER	50	50	50	50	104
PROJECT ENGINEER	50	100	75	84.375	175.5
ASSISTANT PROJECT ENGINEER	10	100	100	88.75	184.6
FIELD SUPERINTENDENT	25	100	100	90.625	188.5
MEP SUPERINTENDENT	25	100	50	71.875	149.5
FIELD ENGINEER	50	100	100	93.75	195
FIELD ENGINEER	0	100	50	68.75	143
FIELD ENGINEER	0	100	0	50	104
FIELD/SAFETY ENGINEER	0	100	100	87.5	182
SECRETARY	0	100	100	87.5	182
ACCOUNTANT	10	25	25	23.125	48.1
COST ENGINEER	25	20	20	20.625	42.9
PURCHASING ENGINEER	100	25	25	34.375	71.5
IT TECHNICIAN	5	10	5	7.5	15.6

Figure 16 – Project Staffing Contributions

The general conditions estimate is broken down into three parts: administration expenses, temporary facilities, and general operations. The administrative costs make up the bulk of the general conditions estimate at around 62% of the total. The total general conditions estimate totals $6,195,079 which is approximelty 9.6% of the total construction cost. The complete breakdown of the general conditions estimate is provided in Figure 17.

- Administrative Expenses = $ 3,862,625
- Temporary Facilities = $ 839,752.50
- General Operations = $ 1,492,701.85
- **Total General Conditions = $ 6,195,079.35**

GENERAL CONDITIONS

PROJECT: Monongalia General Hospital Addition & Renovations LOCATION: Morgantown, WV
OWNER: Monongalia General Hospital

			Labor			Material		
Description	Qty	Unit	Unit Price	Burden	Cost	Unit Price	Cost	Total Cost
01300 Administrative Expense								
MANAGEMENT & SUPERVISION								
Project Manager	104	wks	$3,375		$351,000			$ 351,000.00
Field Superintendent	188.5	wks	$3,125		$589,063			$ 589,062.50
MEP Superintendent	149.5	wks	$3,125		$467,188			$ 467,187.50
ENGINEERING & SAFETY								
Project Engineer	175.5	wks	$3,125		$548,438			$ 548,437.50
Assistant Project Engineer	184.6	wks	$2,100		$387,660			$ 387,660.00
Field Engineer	195	wks	$1,800		$351,000			$ 351,000.00
Field Engineer	143	wks	$1,800		$257,400			$ 257,400.00
Field Engineer	104	wks	$1,375		$143,000			$ 143,000.00
Field/Safety Engineer	182	wks	$1,375		$250,250			$ 250,250.00
OFFICE & SUPPORT								
Secretary	182	wks	$1,125		$204,750			$ 204,750.00
Accountant	48.1	wks	$1,675		$80,568			$ 80,567.50
Cost Engineer	42.9	wks	$1,775		$76,148			$ 76,147.50
Purchasing Engineer	71.5	wks	$1,775		$126,913			$ 126,912.50
IT Technician	15.6	wks	$1,875		$29,250			$ 29,250.00
Administrative Expense Totals								**$ 3,862,625.00**
01500 Temporary Facilities								
PROJECT UTILITIES								
Temp. Power Hookup & Dist.	3050	CSF flr	$11.05		$33,703	$2.63	$8,022	$ 41,724.00
Temporary Lighting	3050	CSF flr/mnth	$2.85	36 mnth	$312,930			$ 312,930.00
OFFICE UTILITIES								
Office Utilities	42	mo	$165		$6,930			$ 6,930.00
Job Telephone/Fax	42	mo	$88		$3,696			$ 3,696.00
Office Supplies	42	mo	$94		$3,927			$ 3,927.00
Furniture & Equipment	42	mo	$410		$17,220			$ 17,220.00
SITE EQUIPMENT & POTECTION								
Rubbish Chute	60	LF	$23.50	x 2	$2,820	$44	$5,280	$ 8,100.00
Dumpster	182	wk		x 2		$1,160	$422,240	$ 422,240.00
Fences	1950	LF	$1.69		$3,296	$7.75	$15,113	$ 18,408.00
Signs & Barricades	225	SF				$17.90	$4,028	$ 4,027.50
Fire Protection	10	each				$55	$550	$ 550.00
Temporary Facilites Totals								**$ 839,752.50**
01500 General Operations								
PERMITS LICENSES & TAXES								
Building Permit		job				0.10%		$ 64,682.00
BOND INSURANCE								
Performance Bond		job	1%					$ 646,820.00
Liability Insurance		job	1%					$ 646,820.00
UTILITIES								
Power Bills	42	month	$110		$4,620			$ 4,620.00
Water Bills	42	month	$62		$2,604			$ 2,604.00
Chemical Toilet	42	month		x 8		$80	$26,880	$ 26,880.00
TESTING & INSPECTION								
Inspector	20	days	$245		$4,900			$ 4,900.00
Onsite Video Camera	42	months				$565	$23,730	$ 23,730.00
CLEANUP								
Periodic Cleanup	305.00	MSF	$34		$10,370	$4.50	$1,373	$ 11,742.50
Final Cleanup	305.00	MSF	$47		$14,335	$6.61	$2,016	$ 16,351.05
Punchlist & Warranty		job	0.02%					$ 12,936.40
Glass Cleaning	305.00	MSF	$97		$29,585	$3.38	$1,031	$ 30,615.90
General Operations Totals								**$ 1,492,701.85**
General Conditions Subtotal								**$ 6,195,079.35**

Figure 17 – General Conditions Estimate

Analysis 1: IRCA Research and Planning

Introduction

Renovation projects pose a multitude of problems to the areas still occupied in building. Construction is a very dirty process in which airborne particles can infiltrate the occupied areas causing inhalation of harmful construction debris. The harmful airborne particles from construction debris are even more detrimental on a health care building with fragile patient's lives at risk. New construction and renovations on health care buildings require early involvement and planning to ensure proper steps are taken to prevent transmission of infectious agents from the workspaces from entering the vulnerable patient facilities.

Goals and Objectives

An essential first step on an addition or renovation project is conducting an Infection Control Risk Assessment (IRCA). This assessment provides the foundation for long range planning, as well as for each phase of the project from concept to completion to reduce the risk of infection. The main goals in this section are to understand the infection control processes and provide my own recommendations on some specific practices that should be implemented on the Monongalia General Hospital Addition and Renovations Project.

Research

The American Institute of Architects (AIA) has published guidelines for the design and construction of hospitals and healthcare facilities. Federal and state healthcare providers have adopted them as their guidelines for design and construction of facilities. Many states have also adopted them as minimum standards.(Bartley) Both the Center for Disease Control (CDC) and the AIA recommend an ICRA to be performed to determine the potential risks.(OR Manager) The facility owner should develop a multidisciplinary team with at minimum the heath facility's infection control/epidemiology department, infection control committee, and administrators, to aid in the planning and design phases as well as monitor the effectiveness of the mitigation plans as the project progresses.(Bartley) The team is needed not only with the design and planning phases but also into construction, such as coordination with facility management to identify necessary support structures required to prevent and control contamination. The significance of this team and its roles throughout the project are critical to maintaining proper mitigation of infectious risk.

An ICRA centers on not only the area in which the construction work is performed but also the adjacent rooms and areas around and above the project workspace. Knowledge of the airflow patterns and pressure differentials helps minimize contamination into the patient space. For example, in an investigation to *invasive aspergillosis* outbreak in a leukemia and bone marrow transplant unit was attributed to depressurization of the unit during construction in an adjacent building.(U.S. Dept.) Depending on the location of and extent of the construction, patients may need to be relocated to other areas in the facility not affected by the construction, especially immune compromised patients.(U.S. Dept.)

The new tower addition is located directly south of the existing building. The excavation alone for the new tower generates a considerable amount of dust and debris in an area very close to an occupied hospital facility. In a building related illness study, peak concentrations in outdoor air at grade level and HVAC intakes during site excavation averaged 20,000 CFU/m^3 for all fungi and 500 CFU/m^3 for *aspergillus fumigatus*. This is compared with 19 CFU/m^3 and 4 CFU/m^3 respectively in the absence of construction.(U.S. Dept.) Prior to demolition and construction activities, proper review of the proximity of the air intake system relative to work and high debris areas as well as the adequacy of the window and door seals, should be conducted to identify infiltration risks for the activity.(U.S. Dept.) This practice should be common practice prior to all activities.

Educating the construction workers about these precautionary measures may be required. The workplaces practices are different on a healthcare facility project. This is especially true with large scale construction such as an addition adjacent to an occupied working hospital. Similarly construction workers working on the renovations within the hospital building require education on the proper protocols for infection control. The Workers should be able to spot trouble areas such as open or unsealed windows, excessive moisture, appropriate traffic flow, work area cleanliness, clean zone entrance and exit procedures, etc. Various education materials used to heighten awareness can help inform workers about the consequences of noncompliance with site rules and regulations regarding infection control. Specific standards and guidelines need to be formed, monitored, and strictly enforced. In the case of non-English speaking workers additional education materials in their spoken language should be provided. Incorporating such specific standards and guidelines should also be incorporated into contracts to enforce adherence to infection control for the duration of the project.

Throughout the entire process of the project, proactive strategies can help prevent incidents from occurring. The key components to mitigating risks are knowing and evaluating the situation, developing an approach, and adhering the plan, all while monitoring and reassessing throughout to ensure proper control.

<u>ICRA Matrix for the Monongalia General Hospital Addition and Renovations</u>

I completed my own ICRA using the Matrix of Precautions for Construction & Renovation. A sample copy of the ICRA is provided in Appendices. The outcomes of steps 1-3 are listed below:

- ✓ Step One: Construction Type – D
- ✓ Step Two: Patient Risk Groups – Medium, High, and Highest
- ✓ Step Three: Class of Precautions – IV

Description of Required Infection Control Precautions for Class IV	
During Construction	Upon Completion of Project
1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Dept	1. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop area with disinfectant. 6. Upon completion, restore HVAC system where work was performed.

Figure 18 – Description of Required Control Precautions for Class IV

The remaining steps, 4-14, help breakdown the specific risk areas surrounding the construction, their impacts and considerations for assessing the risk to these areas. A set of questions are provided for the team to consider against their plans and to identify the compliance with the AIA guidelines.

<u>Recommendations</u>

A ton of research has been conducted involving airborne infection in healthcare facilities, with or without construction. After reading through many papers and articles and speaking with doctors and hospital administrative personnel, I realize how vital certain units are to airborne and waterborne infectious diseases. I feel the most important aspect on a healthcare facility project is the safety and wellbeing of the patients and occupants. After all, the success of the facility is in the care of the patients and should be no different during construction.

The first and foremost plan of action, before any planning or designing, is to organize a multi-disciplinary team to coordinate the various project stages. New construction, large renovations, and high complexity project should always consist of these key personnel to advise the project and infection control measures in the right direction.

- Infection control personnel, including epidemiologists
- Facility administrators
- Facility managers, operators
- Program directors (ICU, oncology, etc.)
- Information systems personnel
- Architects, designers, engineers, project managers, etc.
- Construction managers, superintendents, contractors, etc

After the team is organized they should perform an ICRA, similar to what I have done, to aid with the planning and design, as well as providing a strategy to mitigate environmental hazards and infection. Additional ICRAs should also be performed for subsequent areas and phases along the way. The infection control/epidemiology specialists should be proactive in the design to organize the spaces as to minimize sources of infection in critical patient care areas.

As the project moves towards construction policies should be established for the contractors and workers, for their part in reducing transmission of infections throughout the construction process. A well designed policy which incorporates the ICRA can help ensure everyone understands the team's plans. Expectations and accountability for contractors need to be clearly outlined. Education for all workers and personnel should be available and possibly made mandatory.

Before project activities begin an Infection Control Permit should be completed and submitted. An example of such is located in the Appendices. Daily monitoring of the work areas are also important to maintain ICRA precautions and general workplace safety and sanitation. Daily monitoring forms can and should be used by site managers and superintendents to document the work area monitoring. An example of a daily monitoring form for ICRA precautions is located in the Appendices.

Various equipment is used in and around the work areas to control and isolate dust and debris from entering the healthcare facility. Some of these are outlined as mandatory in the "Description of Required Infection Control Precautions for Class IV" chart. These include High Efficiency Particle Air (HEPA) filters to clean the air or dust and debris. For long range project which may produce larger amounts of dust typically use rigid noncombustible walls constructed of drywall or similar material, and covered with fire resistant sheet plastic curtains. Tack mats should also be used in construction zone entry to control dust and dirt from entering. Towards later stages of construction in finished areas or areas of critical interest, protective outer clothing for workers should be removed and replaced with paper cloth coveralls that are removed each time when exiting the area.

Proper commissioning on a healthcare facility it is very critical. Different patient units have environmental standards in place to prevent unnecessary infections. In order to ensure these rooms are built as designed to the required standards, testing must take place. An example of such is the amount of air changes per hour within the space, to provide enough new clean filtered air into the space. Commissioning of all HVAC in newly constructed and renovated spaces need to be well before occupancy, with high emphasis on ensuring proper ventilation rates as mentioned.

Conclusions

Throughout the entire planning, design, construction, and commissioning stages of the project monitoring environments weather by ICRA assessments, visual inspections, or airborne-particle sampling, is critical for continuous infection risk mitigation. The recommended practices are only a few of a long list of more specific practices to help mitigate airborne illnesses due to construction. The key is to have a team of diverse and knowledgeable individuals to evaluate plans from all angles and provide input to properly control the risk of infection on the project.

To sum up a lot of information with a few key points, I have made a chart (Figure 19) of basic infection control measures. The chart and information in this section are by no means the extent of infection control and risk assessment on healthcare facility projects. The research and technology in this area is evolving and increasing to continually provide practitioners with tools to keep patients safe and healthy.

Basic Infection Control Measures	
Prepare	• Put together a multi-disciplinary team • Conduct ICRA's before and throughout phase and activities • Develop guidelines for specific areas and activities • Develop standards for all firms and companies to adhere to
Educate	• Educate staff and workers about precautionary measures used on the project • Provide sessions and materials to educate • Get everyone on board with being proactive • Post signs to identify construction zones and high risk areas
Relocate	• Indentify high risk areas and patients and relocate them to safer areas • Designate areas for construction worker use only • Reroute patient traffic away from construction areas • Reroute construction traffic from high risk areas
Control	• Erect appropriate barriers for containment; ensure proper seal at all time • Clean construction zones daily, vacuum with HEPA filter equipped vacuum • Mist debris and cover disposal carts before transport • Schedule debris removal when patient exposures are minimal • Do not install wet porous building materials • Use tack mats within the construction zone at the entry • Use an anteroom as needed • Use particle sampling to monitor the air
Ventilate	• Exhaust air and dust to the outside • Shut off all return air vents from construction zones • Set construction areas to have negative air pressures relative to adjacent spaces • Use air flow monitoring devices to verify direction of the air pattern • Monitor air temperature, air changes per hour, and humidity levels • Use portable industrial grade HEPA filters in work zones • Use portable industrial grade HEPA filters in adjacent areas
Complete	• Flush main water systems to clear of dust and debris • Terminally clean the construction zones before removing barriers • Verify appropriate ventilation parameters • Clean or replace HVAC filters • Commission the spaces to insure proper system function and required engineering specification have been met, especially in critical care areas

Figure 19 – Basic Infection Control Measures

Analysis 2.1: Owner Assistance

Introduction

One of the biggest challenges that many construction companies have is the owner-client relationship. This may pertain to not only the construction companies but also with design, engineering, and consulting firms as well. As with most hospitals, the Monongalia General Hospital does not have very much experience when it comes to building. The existing hospital building opened in 1977. Since then, the hospital has had no major construction projects, leaving the hospital team very inexperienced when it comes to a construction project.

Problem

Many of the owners in this industry do not have the knowledge or experience to make many important decisions on a project. In this specific project the owner posed a great deal of challenges during the course of design and construction, most of which because of inexperience. In order for the owner to get exactly what they want in a project, they have to be more instrumental in the project processes, but in order to do so need to fully understand them. The high amount of problems in design, construction, and the overall project due to the owners themselves, is an issue that needs to be addressed.

During the course of the project the teams found themselves educating the owner while still allowing them to make discussions on their own, often resulting in constructability challenges along the way. This constant communication, coordination, and most importantly cooperation between teams, is a struggle that impacts the construction of the project in all aspects. An inexperienced owner may not realize impacts certain decisions have on the project cost or schedule and expect unrealistic outcomes.

The effort to aid owner decisions, satisfy them, and maintain the project schedule makes a hospital addition and renovation project that much more challenging. Since the project broke ground with only 70% construction drawings, the architect was forced to deliver 100% construction documents before really coming to complete design. Multiple items were not completely decided upon before the completion of the drawings and therefore required additional RFI's in order for the owner to specify exact items in time. One specific example was the choice of brick for the exterior veneer, which was not decided upon until late in construction. Also, various interior finish items were left unspecified or changed resulting in additional RFI's and change orders.

Goals and Objectives

Many costly changes later in the project due to indecisiveness from the owner can be alleviated with the addition of some sort of owner assistance. The added cost of hiring an owner's rep may pay for itself by reducing costs such as delays or changes. To minimize the impact of an inexperienced owner on the project, the addition of an owner consulting or acting agency can be contracted by the owner to reduce the barriers between the owner and the project. I hope to find out whether this proposed solution of owner assistance for the Monongalia General Hospital Addition and Renovation Project would be helpful in alleviating knowledge and relationship barriers between the project teams. The study for this project will hopefully provide a base for all healthcare facility projects as the industry is seeing a rise in projects in this field. The rise in healthcare projects and high percentage of inexperienced project owners leads to a need for awareness that owner assistance is a good thing. I aim to find the real costs versus savings of brining on another player into the project mix to help manage the project from the owner's perspective.

Methods

The bulk of the information obtained is from research on past healthcare facility projects with and without owner assistance. The research is mostly obtained through a number of practicing industry professionals. The industry professional interviews were conducted with professionals from various viewpoints and stages of a project. The interviews were conducted in a discussion manner rather than a structured question and answer session, due to the varying professionals' background and experience. After the discussions of first hand experiences on healthcare facility projects with and without owners reps, the information is summed to find a general consensus.

Analysis

The research began by gathering information on probable interview subjects who had any insight on the topics being investigated. Eventually, I obtained a list of professionals ranging in experience from different sides of projects, healthcare and non-healthcare, with and without owner assistance. After contacting the professionals and hearing back with their responses, phone and face-to-face meetings were arranged. The main goals of the interviews were to gather information and discuss the topic. Due to the informal discussions to gather real life industry information, the interview process did not involve gathering information to quote industry members directly. I gathered the information for my research and analysis and therefore the professionals will remain anonymous, in order to protect myself and others from misinterpretation or documentation of information.

The first industry professional I spoke with has project management experience with a construction management company. Over the years he has been on multiple healthcare facility projects. Each project varied in size and complexity and various levels of owner experience. Some owners chose to hire a rep while some didn't.

One example project discussed was a health clinic by a local healthcare center. The owner on this project was said to be fairly experienced with construction projects, had in house project managers to aid in such projects, and didn't have any other construction projects going on at the time. Needless to say, they still chose to hire a representative to aid them throughout the project. In this project the owner's rep acted as the client, being the point of contact for the construction teams. The reps for the project were from a well known firm, but the actual individuals who were appointed to this project were young and inexperienced.

The construction team faced a number of problems with the reps throughout the project. Since the reps were the point of contact for the construction team, is crucial that they actually be accessible to the teams. There were many times on the project that the reps weren't very accessible to the construction team, spending very little time onsite. This often led to a communication breakdown on whom to contact for information. The overall consensus taken from this project was that the use of the reps actually led to more barriers then if the project had been without.

A second example project discussed was a parking garage by the same owner as previously discussed. In this case the owner rightfully chose not to hire an owner's rep. Without the rep in the way this time the project went smoothly. This may partly be due to the low complexity of the project scope. The only issues noted on this project were that the construction team was often pulled into meetings where an owner's rep with construction experience could have taken their place. The time spent in meetings could be better spent on other construction management duties or otherwise reduced from the project costs.

A third project example discussed with this professional was a multi phase renovation of a hospital building. The owner in this case was less sophisticated as the previously mentioned. This project did use an owner's rep as aid to the owner team. Contrary to the other owner rep project, this project went smoothly. The rep spent more time on site, attended all meetings, and provided a single source for information for construction team. The teams greatly benefitted from this single source contact which remained in good communication throughout. The overall consensus about the choice to bring on an owner's rep for this project was favorable.

The last project looked at was a new hospital building. For this project the owner did chose to hire an owner's rep for the duration of the project. This rep also spent more time on sight aiding in the availability for information. This project didn't really have many positives or negatives with respect to the owner's rep. The question in this case would be, was the owner's rep really needed? Was the rep worth it to the owner? The industry professional couldn't really swing one way or the other, seeing as the owner would have to make the call on whether the extra costs were worth it. On the other hand, even though no specific examples of the owner's rep helping out so much as to save problems that would have escalated if it weren't for them, it is hard to say that there wouldn't be any if they weren't used for the project.

The second industry professional I spoke with has both has construction management experience as well. The discussions with him were not about specific projects as they were with the previous. Instead he helped me look for aspects in a project that may help decipher which projects may pose more problems in which an owner's rep may eliminate. The two first areas discussed were the very same red flags which caught my attention for the need of owner assistance. The first of which being owner inexperience. Depending on the owner's needs during the project a rep is almost always helpful to an owner that isn't used to the commercial construction process. The second one, alone and in conjuncture with inexperience, is healthcare facility projects. Most of these projects require a lot of input from the building occupants and facility managers. The wide range of needs from unit to unit in hospital buildings requires input from all department heads and administrators. The collaboration of everyone to come up with a project design can greatly benefit from an experienced construction industry professional to raise awareness to the team about constructability and overall project processes they may not be familiar with.

The third industry professional I spoke with has experience on both the construction and owner sides of a project. The topic of our discussion was also more geared towards when an owner's rep is needed on a project and whether they are worth it to the owner as well as all of the project teams. When weighing the pros and cons of an owner's rep, the value to the overall project including construction and design teams needs to be assessed. I was reminded that the overall project is what should be looked at and not just the owner or construction manager. Also the costs of an owner's rep may not only be in dollars, when such a topic is so hard to quantify.

This brings me the examples more specific to the Monongalia General Hospital Project. Some examples mentioned earlier about changes to design and materials, and decisions not made in early enough especially with longer procurement items, led to cost escalations and schedule delays. The complexity in quantifying the numbers resulting from these issues has led me to difficulty comparing the costs and therefore coming up with a straightforward answer to this issue. Even if I calculated the cost of a rep for the duration of the project to find the monetary cost to the owner of hiring a rep, it won't tell me the success of the project. As seen in the one project example discussed where an owner's rep posed more problems than if they wouldn't have been used, the outcome is not always simple. I can only use previous example cases and experience as my judgment to make an educated conclusion.

One might ask why the construction manager or designer didn't provide this service. After all, it is part of their job to deliver the project and all that it entails, especially for the design-builder. The contracts play a huge role in the involvement of the design and construction team in aiding the owner. In the end the overall goal of a successful project should be more then the just contracts and money to the teams.

Conclusion

Unfortunately I do not have the numbers, data, or charts to illustrate the big conclusion we all have been waiting for. I can however make a now educated guess on the matter. After all this is what this industry is all about. If there's one thing for sure, it's that nothing is a sure thing. Now with a greater insight on owner's representatives and healthcare facility projects I can still say that the Monongalia General Hospital Addition and Renovations Project needed some sort of owner assistance and guidance to reduce unnecessary owner related delays on the project.

Whether the aid come from an owner's rep, the design team, or the construction team, the owner lacked the knowledge and experience to manage a project of this size and magnitude without the additional help. The additional analysis on the project delivery structure, stemming from a lack of more conclusive data in this analysis, and the ensuing conclusions may shine a better light on how to better structure the project delivery to this project and owner characteristics.

Analysis 2.2: Project Delivery

Introduction

While looking into the need for owner assistance on the Monongalia General Hospital Addition and Renovations Project, the question on the particular delivery method and organization for the this project was brought up a few times. This sparked interest others and me as to whether the delivery method added to the confusion within the teams.

The project delivery system is essentially design-build, with the builder being FreemanWhite. They hold the main GMP contract with the owner, Monongalia General Hospital. The construction manager, Turner Construction, holds a GMP contract directly with FreemanWhite. Any other design and engineering subcontracts are held with FreemanWhite and the subcontractors with Turner. To add to the mix, the contract between FreemanWhite and Turner for construction services was issued with only 70% design completion.

Problem

As evident by the uncommon project organization and delivery methods, as well as the inexperienced owner issues, the project had a lot going against it from the start. A combination of the two provoked many challenges, that I feel could have been avoided. The first is addressed in the previous owner assistance analysis section. The project delivery structure needs to also be assessed to determine if it can be improved to provide the project with a better means of delivering the project. A more straight forward and simple project delivery more common to the industry may be better for the overall project.

Goals and Objectives

The main goal of this section is to analyze the project delivery structure to determine which alternative delivery system would work better for this project. Using information about the owner, project teams, and project goals and constraints I will propose a new project delivery system. The system components will include delivery structure, procurement method, and contracting method. I hope to find an alternative delivery method more suitable for the project.

Methods

To come up with the project delivery system for the Monongalia General Hospital Project I used a selection tool to aid in the selection of the system based on project information. The tool I used is the PDCS tool. This tool uses a set of weighted factors to in an excel worksheet to score the project delivery systems. A set of project criteria is required for both tools to determine the most critical aspects for a successful project.

<u>Analysis</u>

The first step to completing a project delivery selection tool is establishing the set of criteria to which decide the success of the project. Based on these criteria, the tool aids the user pick the most probable delivery system to use on the project. I have developed a list project assumptions and criteria based on my knowledge of the project, obtained throughout the year. The criteria used in my analyses are what I believe to be critical to the successful completion of the project.

PDCS:

The PDCS tool has a list of defined factors to choose from as the critical components of the project. After selecting the factors they are rated based on importance, as some factors may weight heavier on the project then others. The ones I choose are outlined in Figure 20 and include the weight assigned to each.

Factor Action Statement	Preference Rank	Preference Scores	Normalized Preference Weight
Control cost growth	2	8	0.27
Control time growth	1	10	0.33
Ensure shortest schedule	3	5	0.17
Promote early procurement	4	4	0.13
Efficiently utilize poorly defined scope	5	3	0.10
		30	

Figure 20 – Project Factors Rankings and Ratings

Next, the aggregate scores for each of the selection factors are transferred into the computational chart to calculate the highest project delivery system. Figure 21 shows the chart with the calculated aggregate scores in the right column. The highest scores are 99 and 94 to PDCS 11 and PDCS 07 respectively.

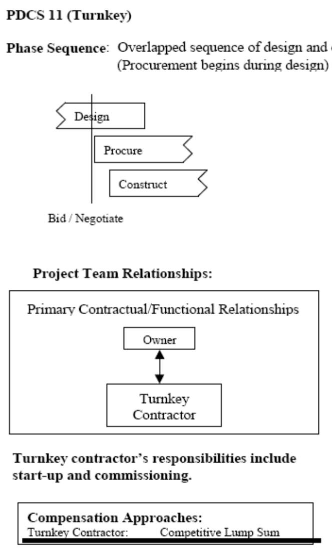
PDCS Alternatives	Factor →	Control cost growth	Control time growth	Ensure shortest schedule	Promote early procurement	Efficiently utilize poorly defined scope	EMPTY	Aggregate Score
↓	Preference Weight →	0.27	0.33	0.17	0.13	0.10	0.00	↓
PDCS 01	Predetermined Effectiveness Values (Table EV-1)	80	20	0	0	70		35.00
PDCS 02		50	50	50	90	60		56.33
PDCS 03		80	20	10	0	50		34.67
PDCS 04		80	20	0	0	40		32.00
PDCS 05		50	50	40	90	40		52.67
PDCS 06		60	70	80	100	70		73.00
PDCS 07		90	90	100	100	100		94.00
PDCS 08		70	80	90	100	80		81.67
PDCS 09		0	0	90	80	0		25.67
PDCS 10		0	0	60	50	0		16.67
PDCS 11		100	100	100	100	90		99.00
PDCS 12		40	80	100	100	80		75.33

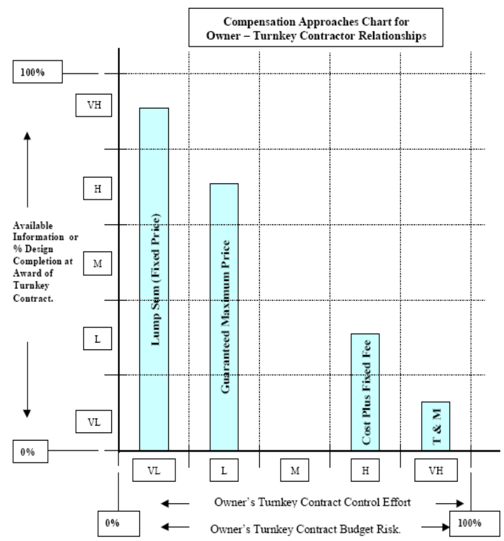
Figure 21 – Scores Matrix

<u>Results</u>

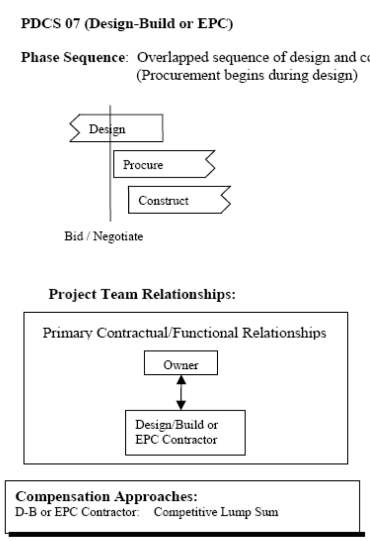
The top scoring delivery methods 11 and 7 are Turnkey and Design-Build or EPC.

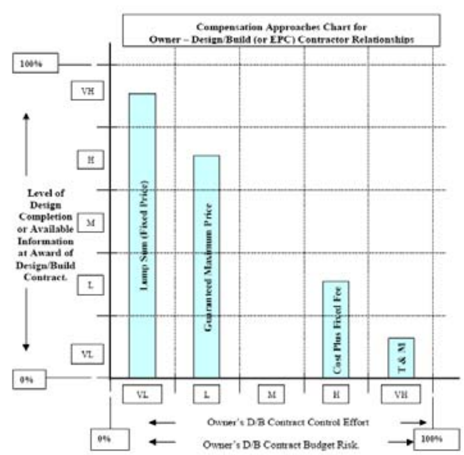
Turnkey – Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts separately with designer and constructor.





Design-Build or EPC – Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts with Design-Build (or EPC) contractor.





Frequency of Usage, based on Research Data*** N = 14

Relationship	Contract Strategy	Relative Frequency of Usage***
Owner – D/B (or EPC) Contractor	Competitive Lump Sum	0.58
	Cost Reimbursable + Fee	0.21
	GMP	0.14
	Negotiated Lump Sum	0.07

} 1.0

Conclusion

The PDCS tool outcome presented me with three viable options for the project based on the criteria I used to define the project. One of the delivery methods is design-build. This is the actual delivery method used for the project. There are some differences between a typical design-build and the methods used on the Monongalia General Hospital Project. These include having the design company as the design-builder instead of the construction manager. This is for various reasons one of which is the larger bonding capacity of construction companies, and not of design companies. This is also because construction managers essentially play a larger role in the overall managing of the project. Construction management companies doing design-build projects either have their own in house design and engineering departments or outsource the design and engineering. The construction manager essentially delivers the entire project via one contact point to the owner. In the case of the Monongalia General Hospital Project, I feel having the design company as the design-builder is the source of a majority of owner decision delays and large lead procurement items. This is not particular to the specific designer on this project but in general. If the designer has to contract the construction management out to a separate company, the essence of design-build is lost. The chain of contracts down the line only acts as a barrier to streamlining processes essential to design-build projects.

A single source entity remains the most effective design-build structure. The design-builder contracted to the owner should essentially be able to deliver the project from start to finish without major subcontracts. The EPC delivery method is basically this. EPC stands for, Engineer, Procure, and Construct. The EPC contractor is responsible to design and engineer the project, procure additional parties and items, and build the project. This method may also help with owner assistance issues as this method is often used with inexperienced owners. Having the EPC entity onboard from start to finish allows them to aid the owner through the design process, alleviating problems down the road. Since the EPC firm is responsible for the construction, early design and procurement items are more likely to be taken care of immediately as to not pose problems for themselves down the road, and to deliver a successful project to a satisfied owner.

Even though this analysis outcome didn't result in a different project delivery system, it did help present some of the problems associated with the delivery structure. This in conjuncture with the owner assistance analysis sheds light onto the some core issues often seen on projects. My recommendation with both analysis topics would be to reassess the design-build entity and delivery method, while still using a design-build system. A design-build or EPC firm with more project start to finish experience on healthcare facilities should greatly reduce concerns with owner inexperience and increase communication streamlines.

Analysis 3.1: Exterior Façade Schedule and Costs

Introduction

The exterior façade on the new Monongalia General Hospital Tower consists of a brick veneer system with metal stud backing. Most of the exterior fenestrations are punch out windows to allow natural light into the working spaces and patient rooms, while public areas such as lobbies use a curtain wall glazing system to accent the aesthetics from both interior and exterior. The brick exterior was chosen to match the existing building's red brick and allow for a seamless and continuous look along the entire exterior.

Problem

The façade brick veneer system is constructed in a traditional hand laid masonry method, resulting in a long exterior enclosure construction time. The exterior envelope construction requires a whole year of work from start to finish. Full exterior enclosure is a critical milestone which allows for interior construction to commence. The lengthy exterior construction lies directly on the project schedule's critical path and is crucial to the remaining activities and the final completion of the project.

Goals and Objectives

Since the hand laid brick façade has such a long construction time and is critical to the forward progress of activities following its completion, I wanted to find a way to reduce this construction time allowing for earlier completion of the project. The change will be approached as a value engineering idea where many factors weigh on the alternate system choice. These factors include but are not limited to schedule, cost, value, quality, compatibility, and constructability. The reduction should inherently yield to cost savings in general conditions costs due to a shortened project schedule. In order for the reducing the construction time to be acceptable, the changes cannot result in an increase of costs in excess of the savings difference from schedule reduction. In the end, an overall savings in both is the most desired outcome. Maintaining high quality, compatibility, and constructability with the building systems and aesthetics, also highly impacts any changes to the exterior façade system.

Alternative System

The design team's choice to continue with the matching red brick was because of how closely tied the new tower building was to existing building. The new tower is an addition to the existing building essentially just creating a larger size of the same building. When deciding how to reduce the lengthy exterior facade construction I choose to focus on the brick veneer, as the punch out windows and curtain wall windows were not the cause for the long duration. Throughout any changes the glazing was to remain the same and assumed to not be a driving impact the resulting changes. I wanted to maintain the continuity in the exterior between the new tower and existing building as the original design had done with the same colored brick.

Initial research to find an alternate brick façade system which could reduce installation time and save costs led me to the Dryvit™ Custom Brick EIFS (Exterior Insulation and Finish System). This exterior finish system uses a layer of expanded polystyrene rigid foam insulation along with a cement type base coating and finish layer. The Custom Brick System is very similar to the base EIFS, but instead of flat finish a brick pattern is used to look exactly like traditional brick.

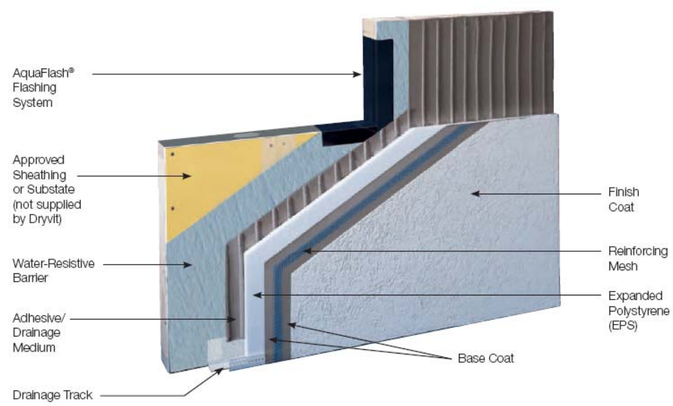
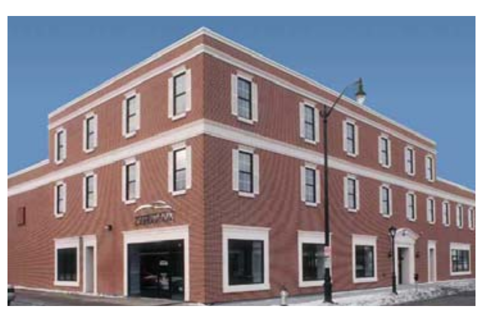


Figure 22 – Dryvit Outsilation Façade Finish System

Compatibility and Constructability

Similarly to the matching of clay brick, Dryvit can match any brick color, maintaining the continuous color and pattern of the existing building's exterior red brick veneer. The simplicity of the EIFS allows it to be used on an unlimited amount of building design combinations. This versatility allows for compatibility with the Monongalia General Hospital Tower Addition design. The construction of the EIFS allows for the same metal stud backup, requiring no changes to the design of the building. The EIFS can be directly applied to the Fiberlock Aqua Tough Sheathing Panels used on the exterior backup wall.



Quality, Value, and LEED

Dryvit may have gotten a bad name for itself due to some water leakage problems a little after the company first started out. Since then the company has greatly developed its water barriers systems and use rigorous tests to ensure well engineered leak proof systems. Dryvit provides a number of different moisture drainage, air resistance, and water resistance systems to fit the needs of the building's exterior construction type. Drvyit Outsulation Systems can be installed in either barrier or moisture drainage configurations. Depending on the system, Dryvit does warranty their products for 10 or 12 years upon substantial completion. When design, engineered, and installed properly Dryvit systems will not leak.

The EIFS system essentially provides an insulation wrapping around the building increase wall R-value and reduce thermal bridging problem areas. The very nature of system involving extra layers of expanded polystyrene insulation is very energy efficient. A more detailed analysis of the thermal properties is provided in the exterior wall thermal analysis section. The insulation can be shaped in to an unlimited amount of designs and patterns to create architectural features such as reveals, cornices, and coins. The exterior finish texture, styles, and colors can be mixed and matched to replicate almost any finish including stucco, limestone, brick, and granite.

In order to produce a quality product Dryvit's facilities are managed to ISO standards:

- Quality Certification: ISO 9001:2000
- Environmental Certification: ISO 14001:2004

Dryvit's systems require lower than average amount energy to produce then other typical exterior cladding systems. Figure 23 shows the resources needed to extract and create the materials used to make the Dryvit outsulation systems including the expanded polystyrene, compared to some other exterior cladding systems.

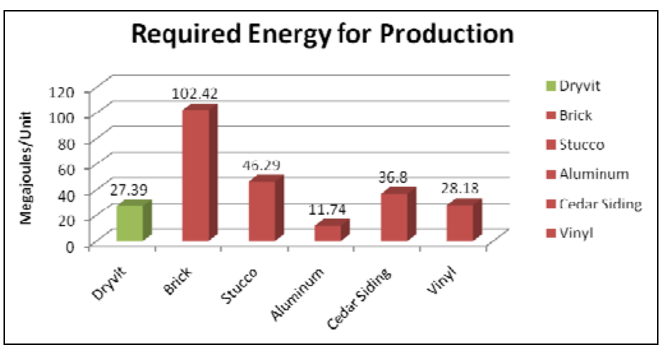


Figure 23 – Required Energy for Production

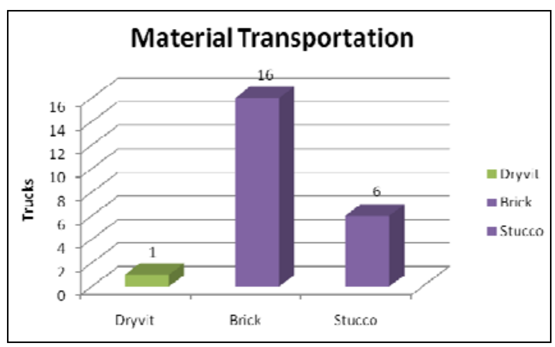


Figure 24 – Material Transportation

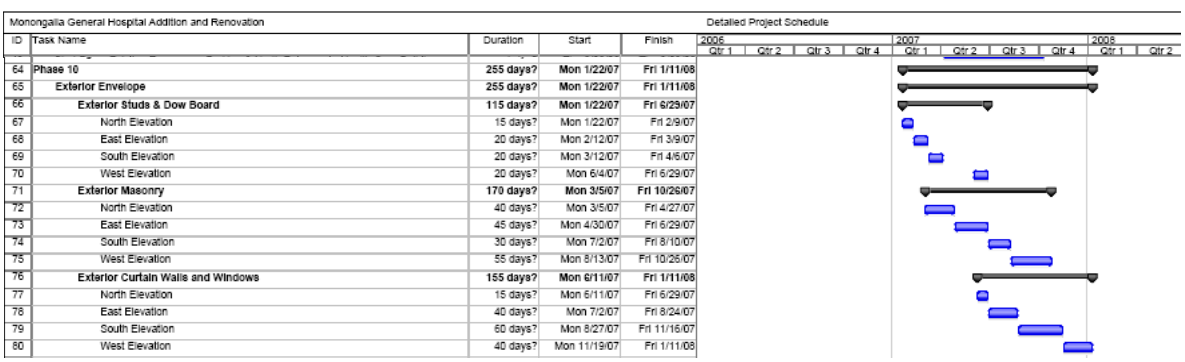
Dryvit systems are incredibly light. This not only helps reduce weight on the structure but also in transportation. A more detailed analysis of the system weights on the building structure is provided in structural analysis section. Figure 24 shows the lower amount of transportation needed for Dryvit systems compared to others, shown by the number of tractor trailers needed to move the equavalent of 25,000 square feet of material.

Dryvit has come a long way from the days of its bad name. Various studies by independent firms have tested and compared Dryvit's systems and manufacturing practices, finding only good results. The use of Dryvit on a building is definitely an addition in value to the building as well as the to the environment.

Comparing the Two: Schedule

The first comparison between the traditional hand laid brick veneer system to the Dryvit Custom Brick finish system is in the construction time. After all, the driving factor in choosing a new system was to reduce the lengthy schedule for enclosing the building. The comparisons for durations are considering only the outermost exterior layer in the exterior wall construction. The metal stud back-up remains the same in both systems and therefore will not influence the construction durations of the outer facades. Similarly, the punch-out windows and curtain wall construction activities should not change in duration length but may change in start date, due to addition or reduction in length of the preceding façade construction activity.

The scheduled duration for the exterior envelope activities are a total of 255 work days, from January 22, 2007 to January 11, 2008. The exterior masonry takes a total of 170 work days, from March 3, 2007 to October 26, 2007. They are constructed by elevation around the building starting with the north and finishing with the west.


Monongalia General Hospital Addition and Renovation — Detailed Project Schedule

ID	Task Name	Duration	Start	Finish
64	**Phase 10**	**255 days?**	**Mon 1/22/07**	**Fri 1/11/08**
65	**Exterior Envelope**	**255 days?**	**Mon 1/22/07**	**Fri 1/11/08**
66	**Exterior Studs & Dow Board**	**115 days?**	**Mon 1/22/07**	**Fri 6/29/07**
67	North Elevation	15 days?	Mon 1/22/07	Fri 2/9/07
68	East Elevation	20 days?	Mon 2/12/07	Fri 3/9/07
69	South Elevation	20 days?	Mon 3/12/07	Fri 4/6/07
70	West Elevation	20 days?	Mon 6/4/07	Fri 6/29/07
71	**Exterior Masonry**	**170 days?**	**Mon 3/5/07**	**Fri 10/26/07**
72	North Elevation	40 days?	Mon 3/5/07	Fri 4/27/07
73	East Elevation	45 days?	Mon 4/30/07	Fri 6/29/07
74	South Elevation	30 days?	Mon 7/2/07	Fri 8/10/07
75	West Elevation	55 days?	Mon 8/13/07	Fri 10/26/07
76	**Exterior Curtain Walls and Windows**	**155 days?**	**Mon 6/11/07**	**Fri 1/11/08**
77	North Elevation	15 days?	Mon 6/11/07	Fri 6/29/07
78	East Elevation	40 days?	Mon 7/2/07	Fri 8/24/07
79	South Elevation	60 days?	Mon 8/27/07	Fri 11/16/07
80	West Elevation	40 days?	Mon 11/19/07	Fri 1/11/08

Figure 25 – Original Project Schedule

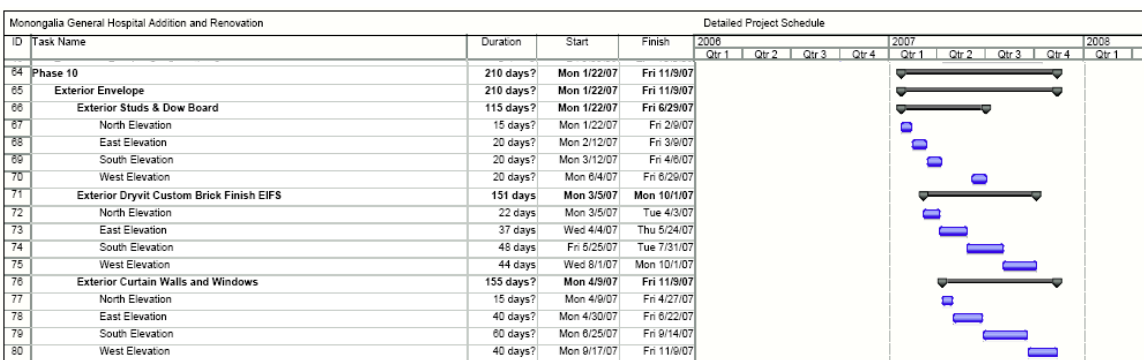
Using R.S. Means 2007 data, I calculated and compared the approximate times to install the EIFS system, as well as the brick veneer system for comparison. The resultant outcomes are 151 days for the EIFS and 194 days for the brick veneer. The wall areas are taken off from the architectural exterior elevation drawings. Since the brick duration used as a base is over the actual duration used in the construction schedule I can only assume a few things as to why this happened. First, R.S. Means data may be slightly over estimated, as it often is with the cost estimates. Second, the actual schedule may be derived from actual historical data in which crew size and productivity may differ from the estimate. In either circumstance the EIFS estimated duration is shorter then both the actual and the brick estimate, by 19 and 43 workdays respectively.

	CREW	DAILY OUTPUT	UNITS	GROSS AREA	DAYS	WEEKS
BRICK	D-8	230	SF	44670	194.22	38.84
NORTH	D-8	230	SF	6525	28.37	5.67
EAST	D-8	230	SF	10915	47.46	9.49
SOUTH	D-8	230	SF	14230	61.87	12.37
WEST	D-8	230	SF	13000	56.52	11.30
EIFS	J-1	295	SF	44670	151.42	30.28
NORTH	J-1	295	SF	6525	22.12	4.42
EAST	J-1	295	SF	10915	37.00	7.40
SOUTH	J-1	295	SF	14230	48.24	9.65
WEST	J-1	295	SF	13000	44.07	8.81

Figure 26 – Exterior Façade Construction Duration Calculations

The resultant savings in time equates to 3.8 weeks when compared to the actual brick construction time and 8.6 weeks when compared to my brick estimate. With this, I can presume to have a schedule savings of at least 3.8 weeks with no straight comparisons of actual brick time verses Dryvit estimate time and no adjustments. With a slight adjustment of over-estimating, I presume a schedule savings of 6.2 weeks. I obtained this number by finding the amount my brick estimated time was over the actual (4.8 weeks), divided it in half (2.4), as to not use the entire amount to be on the safe side, and added that to the difference between the actual brick time and my Dryvit (3.8 weeks). I feel this is a fair adjustment resulting in a range between 3.8 and 6.2 weeks in time savings.

I input the durations calculated for Dryvit construction into the schedule to illustrate the outcome of a four week savings in exterior façade enclosure time.



Monongalia General Hospital Addition and Renovation — Detailed Project Schedule

ID	Task Name	Duration	Start	Finish
64	Phase 10	210 days?	Mon 1/22/07	Fri 11/9/07
65	Exterior Envelope	210 days?	Mon 1/22/07	Fri 11/9/07
66	Exterior Studs & Dow Board	115 days?	Mon 1/22/07	Fri 6/29/07
67	North Elevation	15 days?	Mon 1/22/07	Fri 2/9/07
68	East Elevation	20 days?	Mon 2/12/07	Fri 3/9/07
69	South Elevation	20 days?	Mon 3/12/07	Fri 4/6/07
70	West Elevation	20 days?	Mon 6/4/07	Fri 6/29/07
71	Exterior Dryvit Custom Brick Finish EIFS	151 days	Mon 3/5/07	Mon 10/1/07
72	North Elevation	22 days	Mon 3/5/07	Tue 4/3/07
73	East Elevation	37 days	Wed 4/4/07	Thu 5/24/07
74	South Elevation	48 days	Fri 5/25/07	Tue 7/31/07
75	West Elevation	44 days	Wed 8/1/07	Mon 10/1/07
76	Exterior Curtain Walls and Windows	155 days?	Mon 4/9/07	Fri 11/9/07
77	North Elevation	15 days?	Mon 4/9/07	Fri 4/27/07
78	East Elevation	40 days?	Mon 4/30/07	Fri 6/22/07
79	South Elevation	60 days?	Mon 6/25/07	Fri 9/14/07
80	West Elevation	40 days?	Mon 9/17/07	Fri 11/9/07

Figure 27 – Project Schedule with Dryvit Exterior

The new exterior envelope construction duration with the Dryvit Custom Brick EIFS has a total of 210 days. This brings the full enclosure date from January 11, 2008 up to December 9, 2007, a savings of one month. The subsequent interior activities which rely on the building to be fully enclosed are pushed forward by a month, which results in project completion a month earlier. After the addition is complete, the renovations commence. This month can in turn push the renovations schedule forward, allowing it to finish one month ahead of schedule. The one month savings in time can relate directly to cost savings in overhead for one month. The calculations and resulting cost savings from this are in the next section with the cost comparisons.

Comparing the Two: Costs

The second comparison between the two systems is a cost difference between the traditional brick veneer façade and a Dryvit Custom Brick EIFS. The costs in this comparison involve two factors. First, the overall system construction costs including material and labor, as well as the cost difference in general conditions costs due to schedule changes. The system cost comparisons are for the outermost façade component only, since the metal stud back-up remains the same with both systems.

The actual cost of the brick masonry exterior is $1,590,515. This includes costs for the exterior brick veneer and all components within the assembly including rigid insulation. This does not include the exterior metal stud wall framing and sheathing. The cost for scaffolding is included with the exterior masonry bid.

Using a combination of R.S. Means and local material suppliers I calculated an estimate for the EIFS, traditional brick veneer assembly, and scaffolding to compare costs. The exterior wall areas are taken off from the architectural exterior elevation drawings and include standard overhead and profit costs.

Exterior Costs

- Actual Brick Cost: $ 1,590,515
- Estimated Brick Cost: $ 1,549,526
- Estimated EIFS Cost (R.S. Means) : $ 762,709
- Estimated EIFS (Supplier Quote) : $ 878,851

Exterior Costs per Square Foot

- Actual Brick Cost: $ 35.61 / SF
- Estimated Brick Cost: $ 34.69 / SF
- Estimated EIFS Cost (R.S. Means) : $ 17.07 / SF
- Estimated EIFS (Supplier Quote) : $ 19.97 / SF

Figure 28 compares the costs with and without overhead and profit as well as with and without scaffolding costs. The difference in scaffolding costs between the two systems are due to the one month shorter exterior enclosures schedule as calculated in the previous schedule comparisons section.

	Total	Scaffolding	Total w/scaffolding
Brick Veneer	$1,279,304	$270,222	$1,549,526
EIFS (RS Means Est.)	$509,238	$253,471	$762,709
EIFS (Supplier Quote)	$625,380	$253,471	$878,851

Figure 28 – Cost Estimate Comparisons

The comparison between my brick estimate and the actual are very close and so I can assume the others to be close to the actual as well. The difference in assembly costs between the traditional brick veneer system and the Dryvit Custom Brick EIFS is $711,664. This is a considerable amount of savings of over 44.7%.

Cost Savings with Dryvit Custom Brick EIFS

- Assemblies Savings: $ 711,664

When looking for cost savings from schedule reduction the first effect was evident in the scaffolding costs. The original exterior envelope activities lasted 12 months, while the Dryvit system is estimated to last 11 months, eliminating one month to the enclosures, and reducing the scaffolding costs accordingly. The second cost savings due to schedule reduction is through project overhead costs. Since the project can complete one month earlier, this should in return reduce the overhead costs to manage the project by one month. The total savings in general conditions costs from a schedule reduction of one month during the additions phase is shown in Figure 29.

General Conditions Sections	Original	W/one-month reduction	Savings Difference
Administrative Expense Totals	$3,862,625	$3,767,573	$95,053
Temporary Facilities Totals	$839,753	$838,996	$757
General Operations Totals	$1,492,702	$1,491,325	$1,377
General Conditions Subtotal	$6,195,079	$6,097,893	$97,186

Figure 29 – Comparisons of General Conditions Costs

Cost Savings due to Schedule Reduction

- General Conditions: $ 97,186
- Scaffolding: $16,751

Conclusions

The comparisons between the alternate Dryvit brick EIFS and the traditional hand laid clay brick veneer yield expected results in both cost savings and schedule reduction. While the schedule reduction wasn't a large amount, the goal to reduce the exterior enclosures activities was achieved with the alternate system. The cost comparisons on the other hand do show a significant reduction between the original and the alternate.

Total Time Savings with Dryvit Custom Brick EIFS

- Reduction in workdays: 19 days
- Reduction in Exterior Enclosures Duration: 1 month

Total Cost Savings with Dryvit Custom Brick EIFS

- Assemblies: $ 711,664
- General Conditions: $ 97,186
- Scaffolding: $ 16,751
- Total Savings: $ 825,601

When looking into value engineering ideas all project factors need to be taken into consideration. With this example the cost and schedule reductions may not be enough to warrant the change in the owner's eyes. The choice to stick with traditional brick may be preferred by the owner regardless of the savings an alternate system may provide. Value engineering comparisons like these can at least show the owner some alternatives to the original design that can yield time and cost reductions that increase value for the project.

Analysis 3.2: Exterior Façade Structural

<u>Introduction</u>

Changes in a building's design resulting in weight increases or losses, impacts the structure often requiring structural changes. The Monongalia General Hospital Tower Addition uses cast-in-place concrete for its substructure and superstructure. The flat slab floor system also consists of edge beams at almost all exterior slab edges. More details of the structural system are located in the building systems summaries section.

<u>Problem</u>

The alternate Dryvit EIFS façade is an entirely different assembly then the traditional brick veneer system. The brick veneer system is attached to the concrete structure using a steel lintel system which connects to the concrete with embeds. The brick is supported by these at each floor level. The Dryvit EIFS is light enough to attach directly to the metal stud backing wall and therefore the weight is transferred through it onto the floor. The reduction in weight with the alternate EIFS façade could result in changes to the structural system.

<u>Goals and Objectives</u>

The lighter EIFS façade lessens the load on the building structure throughout the entire perimeter. The primary goal is to once again find savings in the form of a reduction in the structural system components due to lighter exterior façade loads. The reduction will most likely come from a lower requirement of steel rebar reinforcing in the beams.

<u>Methods</u>

For this analysis I chose a common exterior edge beam location and calculate the loads onto the beam. I used the same live and dead loads in which the building used as design criteria. After finding the resulting axial load on the beam I calculated the maximum moments for the beam at the ends and midpoint. Using the maximum moment I obtained, I calculated the amount of rebar needed to in all three locations.

<u>Analysis</u>

The edge beam I analyzed with full calculations was one that was common to interior live and dead loads and exterior façade loads. This was to ensure a location that would be a typical case for the exterior edge beam to get a better overall sample analysis of the impact the façade change has on the beam design specifications.

The beam analyzed, labeled FB533, is on the fifth floor south façade. The façade is a combination of brick, ground faced masonry units, and punch out window. This is typical for the 5th and 6th floor, as the perimeter rooms are patient rooms. A view of a typical exterior elevation is shown in figure 30. Plan views of the edge bay are shown in Figure 33.

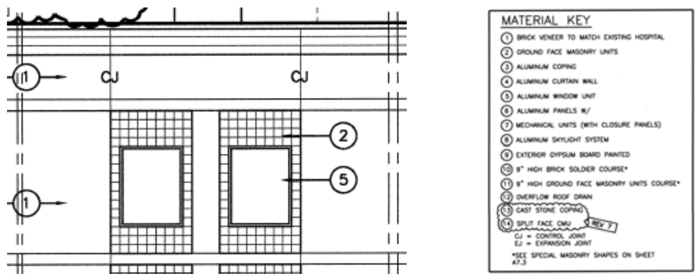


Figure 30 – Typical Bay Exterior Elevation

The bay has a width (along length of beam) of 27' and depth of 30'-4". Additional information used for the calculations is presented in Figure 31.

Building Structural Information
➢ Concrete flat slab floor system ➢ 5,000 psi concrete ➢ Slab thickness – 8" ➢ Column size – 24" x 24" ➢ Beam size (width x depth) – 24" x 18" (typical) ➢ Bay sizes – varied ➢ Floor to floor heights • Floors 1-2: 12' • Floors 3-6: 11.5'

Figure 31 – Building Structural Information

The live and dead loads used for the analysis are taken from the design criteria located on the structural drawings. Most other loads used for the analysis are from AISC (American Institute of Steel Construction, Inc.) Table 17-13: Weights of Building Materials. The specific loads used in my calculations are listed in Figure 32 below.

Live Loads	Dead Loads	Exterior Wall Loads
Private Rooms: 40 psf Public Areas: 100 psf Lobbies: 100 psf Corridors above 1st Floor: 80 psf * psf of floor area	Partitions: 20 psf Superimposed: 10 psf Concrete: 150 pcf * psf of floor area	Brick Veneer: 40 psf Metal Stud Backup Wall: 9 psf Window: 10 psf Dryvit: 2 psf * psf of wall area

Figure 32 – Design Loads

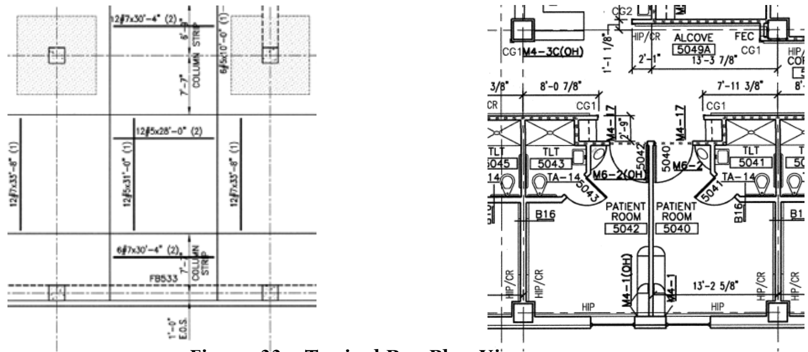


Figure 33 – Typical Bay Plan Views

Live Load Calculations:

$$L = L_o\left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right)$$

$$TributaryWidth = \left(\frac{30'4''}{2}\right) + 1'8'' = 16.84\,ft$$

$$L = 80\,psf\left(0.25 + \frac{15}{\sqrt{2\times(16.84\,ft \times 27\,ft)}}\right) = 59.8\,psf$$

$$L = 59.8\,psf \times 16.84\,ft \;\Rightarrow\; LL = 1007\,plf$$

Floor Dead Load Calculations:

$$FloorSlab = 150\,pcf \times \left(\frac{8}{12}\right)ft \times 16.84\,ft = 1684\,plf$$

$$Beam = 150\,pcf \times 2\,ft \times (1.5\,ft - 8'') = 250\,plf$$

$$InteriorPartitions = 20\,psf \times 16.84\,ft = 337\,plf$$

$$Superimposed = 10\,psf \times 16.84\,ft = 168\,plf$$

Exterior Wall and Façade Loads:

$$SupportedWallArea = 11.5\,ft \times 27\,ft = 311\,SF$$

$$WindowArea = 55\,SF$$

$$PercentWindowArea = \frac{55\,SF}{311\,SF} = 18\% \;\Rightarrow\; PercentWallArea = 82\%$$

$$TotalWallwithBrick = [\{(40\,psf + 9\,psf)\times .82\} + (10\,psf \times .18)] \times 11.5\,ft = 483\,plf$$

$$TotalWallwithDryvit = [\{(2\,psf + 9\,psf)\times .82\} + (10\,psf \times .18)] \times 11.5\,ft = 124\,plf$$

Factored Loads (Wu):

$$Wu = 1.6L + 1.2D$$

$$Wu(Brick) = (1.6 \times 1007 plf) + 1.2(1684 plf + 250 plf + 337 plf + 168.lf + 483 plf) = 5118 plf$$

$$Wu(Dryvit) = (1.6 \times 1007 plf) + 1.2(1684 plf + 250 plf + 337 plf + 168 plf + 124 plf) = 4687 plf$$

Moment Calculations (Mu):

After the factored load for the beam is calculated, the resulting moments on the beam can be calculated. Each moment location uses a different formula for maximum moment calculation. Figure 34 was used to find the correct formula for each moment calculation.

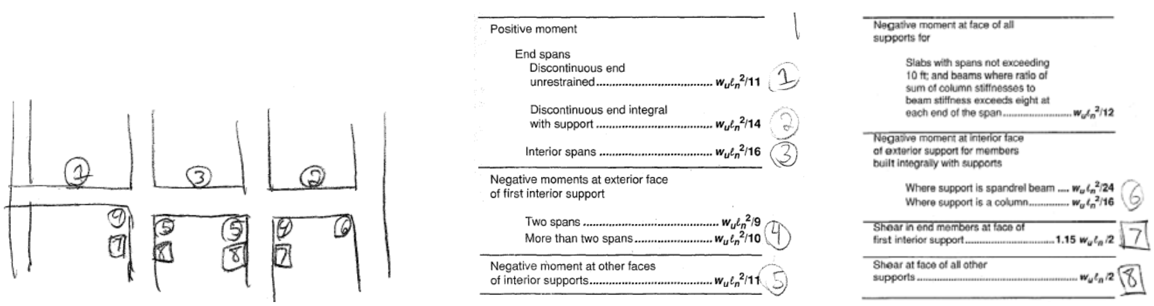


Figure 34 – Moment Calculation Equations

Since the beam I am analyzing is an interior beam I used equation #3 for the positive moment located at center span of the beam and equation #5 for the negative moments at the column supports.

$$-Mu(Brick) = \frac{w_u l_n^2}{11} \qquad +Mu(Brick) = \frac{w_u l_n^2}{16}$$

$$-Mu(Brick) = \frac{5.118 klf \times (27 ft)^2}{11} = 339.2 ft \cdot kips = 4070 in \cdot kips$$

$$+Mu(Brick) = \frac{5.118 klf \times (25 ft)^2}{16} = 199.9 ft \cdot kips = 2399 in \cdot kips$$

$$-Mu(Dryvit) = \frac{4.687 klf \times (27 ft)^2}{11} = 310.6 ft \cdot kips = 3728 in \cdot kips$$

$$+Mu(Dryvit) = \frac{4.687 klf \times (25 ft)^2}{16} = 183.1 ft \cdot kips = 2197 in \cdot kips$$

Steel Reinforcing Calculations (As):

When finding the amount of reinforcing needed in the beam, Mu is set equal to ΦMn. A number of factors, one of them being amount of steel reinforcing, are input into the Mn calculation. Since I already know Mu, I want to find As (area of steel), but don't know Mn, I can use Mu and the equation for Mn to find As.

$$Mu \leq \Phi Mn$$

$$\Phi Mn = 0.9 A_s f_y \left(d - \frac{a}{2} \right)$$

$$a = \frac{A_s f_y}{\beta_1 \times f'c \times b}$$

$$a = \frac{A_s 60ksi}{0.8 \times 5ksi \times 24''}$$

Variables
Steel yield strength: f_y = 60 ksi
Concrete 28 day compression strength: $f'c$ = 5 ksi
For 5,000 psi concrete: β_1 = 0.8
Beam width: b = 24 in
Beam depth (minus coverage and rebar): d = 18"-2"-(3/8)"-(0.875/2)" = 15.1875 in
Tension Controlled Reduction Factor: Φ = 0.9

Set the two M equations equal to each other:

$$Mu \leq 0.9 A_s 60ksi \left(15.1875'' - \frac{\left(\frac{A_s 60ksi}{0.8 \times 5ksi \times 24''} \right)}{2} \right)$$

$$Mu \leq 54 A_s \left(15.1875'' - \frac{0.625 A_s}{2} \right)$$

$$Mu \leq 54 A_s \left(15.1875'' - 0.3125 A_s \right)$$

$$Mu \leq 820.125 A_s - 16.875 A_s^2$$

$$0 \leq -Mu + 820.125 A_s - 16.875 A_s^2$$

Quadratic Equation: $ax^2 + bx + c = 0$

Solving for x: $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

The equation comes out to a quadratic in which I used the formula below to solve for As.

$$A_s = \frac{-820.125 \pm \sqrt{820.125^2 - 4(-16.875)(-Mu)}}{2(-16.875)}$$

By inputting the different Mu's into the equation, I found the minimum area of steel reinforcing needed for the respective moment due to the loads. (Note: Mu needs to be in kip-inches)

$$-Mu(Brick) \Rightarrow A_s = 5.61in^2$$

$$+Mu(Brick) \Rightarrow A_s = 3.13in^2$$

$$-Mu(Dryvit) \Rightarrow A_s = 5.08in^2$$

$$+Mu(Dryvit) \Rightarrow A_s = 2.85in^2$$

Using different bar sizes and their cross sectional areas, I can then find out how much of what size rebar is required. A rebar chart is provided in Figure 35.

Bar Number	Diameter (in)	Cross-sectional area (in^2)
3	0.375	0.11
4	0.500	0.20
5	0.625	0.31
6	0.750	0.44
7	0.875	0.60
8	1.000	0.79
9	1.128	1.00
10	1.270	1.27
11	1.410	1.56

Figure 35 – Rebar Chart

The required amount of steel for each of the moments:

$$-Mu(Brick) \Rightarrow A_s = 5.61in^2 \qquad A_s = 10\text{–}\#7's = 6.0in^2$$

$$+Mu(Brick) \Rightarrow A_s = 3.13in^2 \qquad A_s = 6\text{–}\#7's = 3.6in^2$$

$$-Mu(Dryvit) \Rightarrow A_s = 5.08in^2 \qquad A_s = 9\text{–}\#7's = 5.4in^2$$

$$+Mu(Dryvit) \Rightarrow A_s = 2.85in^2 \qquad A_s = 5\text{–}\#7's = 3.0in^2$$

The positive moment at the midpoint of the beam requires the rebar to be placed on the bottom of the beam while the negative moment at the ends of the beam requires the rebar at the top.

FIFTH FLOOR CONCRETE BEAM SCHEDULE

MARK	W IN.	D IN.	TOP BARS				BOTTOM BARS				STIRRUPS		
			LEFT END	TYPE	RIGHT END	TYPE	LONG	TYPE	SHORT	TYPE	SIZE	TYPE	SPACING "S" BOTH ENDS TYP. U.N.O.
FB533	24	18	---		10–#7		3–#7		3–#7		#3		@ 8" O.C.

The specified amount of rebar for this beam is 6 – #7's for bottom bars and 10 – #7's for top bars. This matches up with my calculations as shown above.

Results

The calculations with the Dryvit EIFS in replace of the brick veneer system yielded a savings of two #7 bars, one for top reinforcing and one for bottom reinforcing. Since my base calculation yielded the same size and amount of bars as specified by the drawings, I assume my calculations are correct. The 5th floor has about 20 edge beams of similar size which I presume to yield the same results. If this is correct, the 5th floor will see a savings of 40 #7 bars each about 27 feet in length. Size #7 rebar has a weight of 2.044 lb/LF.

The 1st floor is slab-on-grade and the 2nd is supported at the exterior by the concrete foundation wall, therefore they will not see any reductions in rebar as in the 5th. Since the 6th floor is essentially the roof, I don't believe to have any reductions on this level. The 3rd and 4th floors however are supported the same as the 5th and have similar interior and exterior loads. Even though the area and exterior wall perimeter is larger on these floors, they don't have as many typical beams like the one I analyzed. The use of different exterior designs and curtain walls reduce the amount of similar bays. By balancing the larger perimeter and more edge beams to the less likeliness for bays to be like the one analyzed, I assume the same amount of rebar to be reduced for each of the two floors. This brings the total to 120 #7 bars, each about 27 feet long, and having a weight of 2.044 lbs/LF. The total rebar weight comes to 6623 lbs or 3.3 tons.

The reduction in reinforcing costs due to a 3.3 ton reduction in rebar results in a savings of $ 5,923.50, as shown in Figure 36.

Description	Quantity	Units	Material Costs	Labor Costs	Total
Cast-in-place concrete reinforcing, Beams, Installed, #3 to #7	3.3	tons	$ 935	$ 860	$ 5,923.50

Figure 36 – Rebar Cost Reductions

Conclusion

The alternate façade system decreased the load onto the building structural on the perimeter edge beams and therefore resulted in a lesser amount of steel reinforcing. The reduction in number of bars in turn saves a slight amount in reinforcing costs. The amount is marginal compared to the total building cost, but it still adds to the savings the alternate system is already seeing through the comparisons.

Analysis 3.3: Exterior Façade Thermal Analysis

Introduction

The Monongalia General Hospital chose the red brick façade for the addition to keep with the look of the existing building creating a seamless look between the two structures. The alternate system consisting of Dryvit's Custom Brick EIFS, provides the same red brick façade aesthetics but with a totally different cladding system.

Problem

A change to the exterior façade finish changes the whole exterior wall assembly's thermal properties. Changes in exterior wall thermal properties can impact the building mechanical system design. The alternate façade system may have a positive or negative impact on the building. Without knowing exactly how the building's thermal properties are going to be affected by a different façade system, I can't fully endorse the proposed alternate system.

Goals and Objectives

The goal in this analysis is to find out the exterior wall system thermal properties on the Monongalia General Hospital. I will analyze and compare the original and alternate façade systems' thermal properties. I will also discuss the impacts of the differences would have on the building.

Methods

The thermal comparisons of the systems will be calculating the total wall R-values and U-values for the exterior walls. Material properties are from ASHRAE and product manufactures. Material thermal information including R-values will be gathered. Using the R-values, various exterior wall assemblies will be analyzed for the total wall R-value. The wall assemblies will include three types for each finish system.

Analysis

The three wall system systems are three which are most common for the new tower addition. These make up almost the entire exterior. The three partitions are shown in Figure 37.

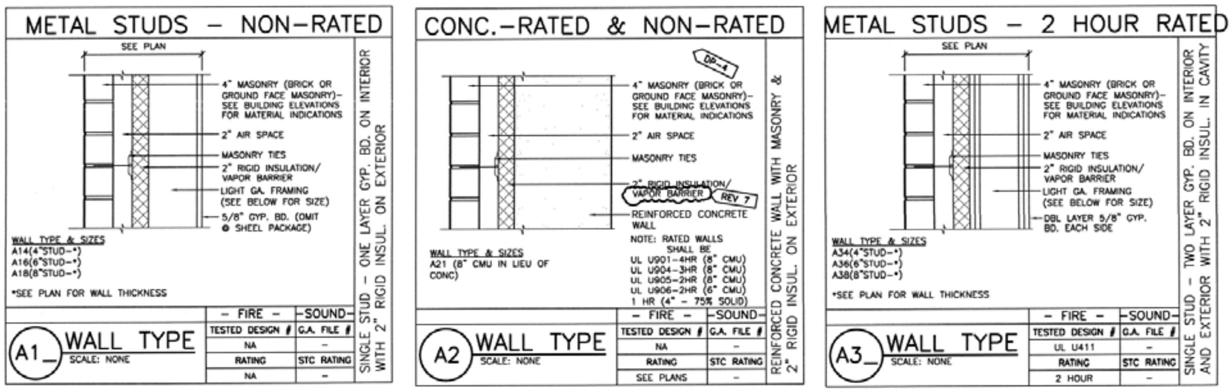


Figure 37 – Exterior Wall Partition Types

The first wall type I looked at was the most common, designated A16. Figure 38 breaks down the wall assembly into the material layers and the r-value for each. The thickness of each material is already calculated into the r-value for each material, so the sum of each is the total wall r-value. All r-values are represented with standard r-value units: (°F-ft²-hr)/Btu

Brick Veneer with A16 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Brick & Mortar	4"	0.8
Air Space	2"	0.9
Rigid Insulation	2"	10
Fiberlock Aqua Tough Sheathing	5/8"	0.38
Stud Air Space	6"	0.91
Gypsum Board	5/8"	0.56
Inside Air Film	-	0.68
		14.40

EIFS with A16 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Finish Coat	negl.	negl.
Rigid Insulation	2"	10
Densglass Gold Sheathing	5/8"	0.56
Stud Air Space	6"	0.91
Gypsum Board	5/8"	0.56
Inside Air Film	-	0.68
		13.88

Figure 38 – Wall Assembly R-Values

Since the brick exterior assembly calls for two inches of rigid insulation between the brick veneer and the stud wall it is actually superior to the EIFS system which also uses two inches of rigid insulation. The stud partition is of six inch metal studs with one layer of sheathing on each side of the studs. This is the same with both systems. The only differences are the four inch brick veneer and the airspace between the rigid insulation and the brick veneer. These two components help the brick wall system to have a better r-value.

The next wall type I broke down and compared is type A2. Figure 39 breaks down the wall type into layers with each layers' r-value for the designated thickness.

Brick Veneer with A2 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Brick & Mortar	4"	0.8
Air Space	2"	0.9
Rigid Insulation	2"	10
Concrete	8"	0.8
Inside Air Film	-	0.68
		13.35

EIFS with A2 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Finish Coat	Negl.	Negl.
Rigid Insulation	2"	10
Concrete	8"	0.8
Inside Air Film	-	0.68
		12.65

Figure 39 – Wall Assembly R-Values

This wall type is used where the elevator shaft wall is along the exterior. The EIFS is applied directly to the concrete wall, eliminating the airspace that the brick veneer system has. Similar to the previous wall type, the brick veneer system uses two inch rigid insulation in between the wall and brick veneer. The combination of the brick material and airspace provides the traditional brick veneer system with a higher r-value.

The third exterior partition type compared is type A38. Figure 40 breaks up the wall into material layers and their respective r-values.

Brick Veneer with A38 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Brick & Mortar	4"	0.8
Air Space	2"	0.9
Rigid Insulation	2"	10
Fiberlock Aqua Tough Sheathing (2-layers)	5/8" x2	0.76
Stud Air Space	8"	0.91
Gypsum Board (2-layers)	5/8" x2	1.12
Inside Air Film	-	0.68
		15.34

Figure 40 – Wall Assembly R-Values

EIFS with A38 Exterior Wall Construction		
Material	Thickness	R-value
Outside Air film	-	0.17
Finish Coat	Negl.	Negl.
Rigid Insulation	2"	10
Densglass Gold Sheathing (2-layers)	5/8" x2	1.12
Stud Air Space	8"	0.91
Gypsum Board (2-layers)	5/8" x2	1.12
Inside Air Film	-	0.68
		15.00

Figure 40 – Wall Assembly R-Values

This partition wall is a fire-rated assembly achieved by using two layers of gypsum sheathing or similar, on each side of the eight inch metal studs. The rest of the assembly is the same as type A16 mentioned earlier. The brick system again results in a higher r-value due to the additional air space and brick material, which the EIFS doesn't have.

Results

Exterior partition wall type A16 yielded a reduction in wall r-value of 0.52 (ºF-ft²-hr)/Btu with the proposed alternative EIFS façade. Partition type A2 also showed a reduction in wall r-value with the EIFS, of 0.7 (ºF-ft²-hr)/Btu. Lastly, partition type A38 again resulted in a lower wall r-value, with a difference of 0.34 (ºF-ft²-hr)/Btu.

Wall Type	Brick Veneer Wall R-values	EIFS Wall R-values	Difference
A16	14.40	13.88	0.52
A2	13.35	12.65	0.70
A38	15.34	15.00	0.34
Average	**14.36**	**13.84**	**0.52**

The average exterior wall r-value for the brick veneer façade is 14.36 (ºF-ft²-hr)/Btu, while the EIFS façade average exterior wall r-value is 13.84 (ºF-ft²-hr)/Btu, a difference of 0.52 (ºF-ft²-hr)/Btu.

Conclusion

In each of the exterior partition analyses and comparisons, the wall assembly which yielded the higher r-value was the traditional brick veneer system. In this case of thermal performance the proposed alternative EIFS does not improve the building's original design. This is due to the two inch rigid insulation which is called for by the design. The two inch rigid insulation advantage which sets the EIFS apart from other assemblies is compromised with the brick veneer system also using two inches of rigid insulation between the stud wall and brick veneer. In addition, the extra airspace also helps increase the r-value.

Although the alternative EIFS does have lower wall assembly thermal properties they are minimal. The average of 0.5 (ºF-ft²-hr)/Btu equates to a u-value difference of 0.00262 Btu/(ºF-ft²-hr), the equivalent of less than 1 Btu transfer in one SF of area with difference of 15 ºF over a period of 24 hours.

Terms and Abbreviations

Aspergillus – fungus that is very common in the environment. It is found in soil, on plants and in decaying plant matter. It is also found in household dust, building materials, and even in spices and some food items.

Aspergillus Fumigatus – common type of *aspergillus (see aspergillus)*

CFU/m^3 – colony forming units per cubic meter (of air)

EIFS – Exterior Insulation Finish System

GMP – Guaranteed Maximum Price

HEPA – High Efficiency Particle Air

HVAC – Heating Ventilating and Air Conditioning

ICRA – Infection Control Risk Assessment

Invasive Aspergillosis – a disease caused by *aspergillus*, that usually affects people with immune system problems. In this condition, the fungus invades and damages tissues in the body. Invasive aspergillosis most commonly affects the lungs, but can also cause infection in many other organs and can spread throughout the body.

Kilo-pound – one thousand pounds (1,000 lbs.)

Kips – Kilo-pounds

KSI – Kilo-pounds per square inch

LF – Linear feet

PCF – Pounds per cubic feet

PDCS – Project Delivery and Contract Strategy

PLF – Pounds per linear feet

PSF – Pounds per square foot

PSI – pounds per square inch

RFI – Request For Information

SF – Square feet

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Acknowledgements

I would like to thank the following for their help and support throughout my senior thesis.

Monongalia General Hospital

Turner Construction Company

Dryvit Systems, Inc.

Manning Materials
John Roehm

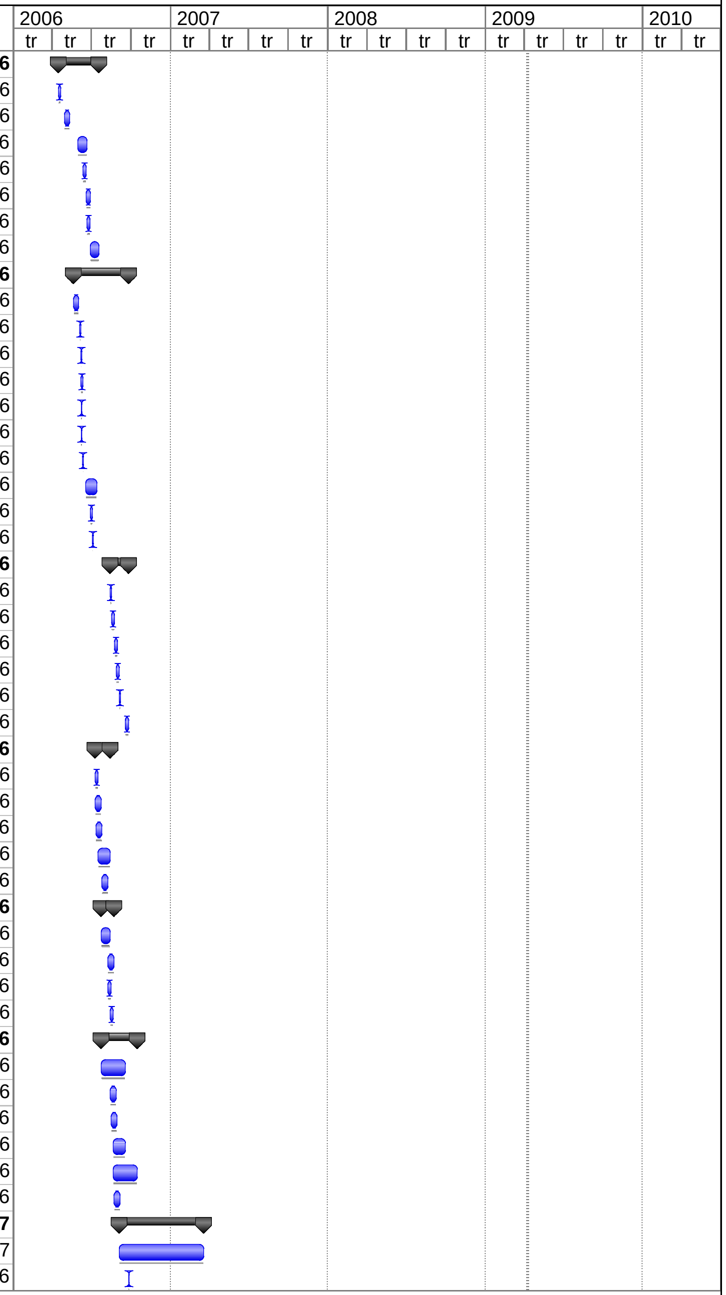
Penn State Architectural Engineering Department
Dr. Riley
Dr. Hanagan

Industry Professionals
Dan Flickinger
John Bechtel
Jim Faust

Appendix A

Project Schedule

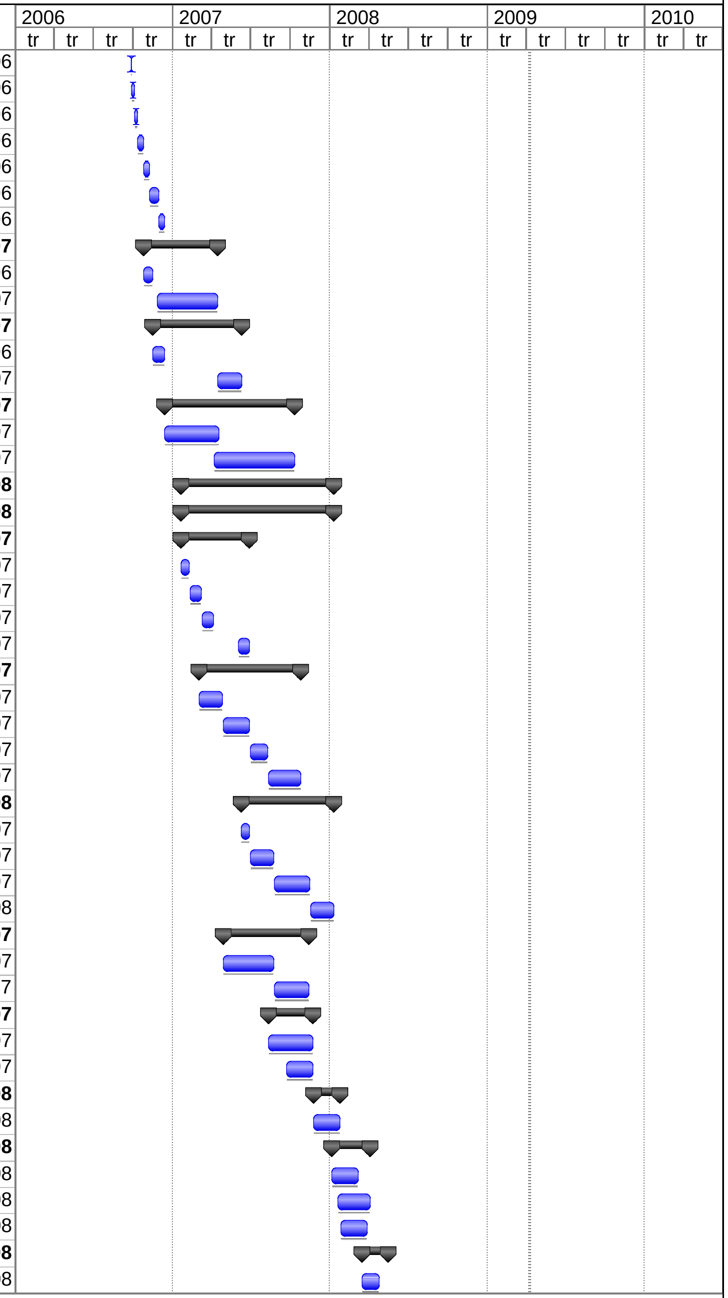
ID	Task Name	Duration	Start	Finish
1	**Phase 1 - Temporary Site Work**	**68 days?**	**Mon 4/17/06**	**Wed 7/19/06**
2	Establish Construction Entrance at Loading Dock Area	5 days?	Mon 4/17/06	Fri 4/21/06
3	Rock Crushing Operation	10 days?	Mon 5/1/06	Fri 5/12/06
4	Pave East Parking Lot	15 days?	Thu 6/1/06	Wed 6/21/06
5	Temporary Fencing Configuration 1	5 days?	Tue 6/13/06	Mon 6/19/06
6	Protect Existing Facility	8 days?	Tue 6/20/06	Thu 6/29/06
7	Establish Temporary Loop Road	5 days?	Thu 6/22/06	Wed 6/28/06
8	Sequence 1 Demolition	14 days?	Fri 6/30/06	Wed 7/19/06
9	**Phase 2 - Establish Safety Routes and Signage (by MGH)**	**92 days?**	**Mon 5/22/06**	**Tue 9/26/06**
10	Establish New 2-hr Horizontal Corridor & Fire Rated Doors	10 days?	Mon 5/22/06	Fri 6/2/06
11	Install Temporary Construction Wall at Existing Stair Demo Location	3 days?	Mon 6/5/06	Wed 6/7/06
12	Remove Existing "Dead End" Corridor Wall	2 days?	Thu 6/8/06	Fri 6/9/06
13	Build New Wall & Change Swing of Stair Door	3 days?	Thu 6/8/06	Mon 6/12/06
14	Change Main Entrance to East Elevation	1 day?	Fri 6/9/06	Fri 6/9/06
15	Close Down Waiting Area & Gift Shop	1 day?	Fri 6/9/06	Fri 6/9/06
16	Install Temporary Corridor Doors	2 days?	Mon 6/12/06	Tue 6/13/06
17	Build Temp MRI Dock & Complete Roadwork & Parking at Central Plant	20 days?	Mon 6/19/06	Fri 7/14/06
18	Remove Screen Wall & Pour Temporary Sidewalk	3 days?	Fri 6/30/06	Tue 7/4/06
19	Sawcut Existing Sidewalk & Install Temporary Handrail	2 days?	Wed 7/5/06	Thu 7/6/06
20	**Healthcare Building**	**31 days?**	**Tue 8/15/06**	**Tue 9/26/06**
21	Install Temporary Walls for Demolition	3 days?	Tue 8/15/06	Thu 8/17/06
22	Demo Existing Bathroom Facilities	5 days?	Fri 8/18/06	Thu 8/24/06
23	Build New Main Entrance Corridor Walls	5 days?	Fri 8/25/06	Thu 8/31/06
24	Demo Exterior Wall for New Emergency Exit & New Main Entrance Doors	5 days?	Tue 8/29/06	Mon 9/4/06
25	Pour Temporary Sidewalk	3 days?	Tue 9/5/06	Thu 9/7/06
26	Build Covered Walkway to South Parking Lot Area	6 days?	Tue 9/19/06	Tue 9/26/06
27	**Phase 3**	**25 days?**	**Tue 7/11/06**	**Mon 8/14/06**
28	Excavate for Tunnel Extension & Central Plant	5 days?	Tue 7/11/06	Mon 7/17/06
29	Excavate Area "A"	10 days?	Tue 7/11/06	Mon 7/24/06
30	Fill Parking Lot Behind Health Care Building	10 days?	Thu 7/13/06	Wed 7/26/06
31	Tunnel Extension & Central Plant Foundations	20 days?	Tue 7/18/06	Mon 8/14/06
32	Fill New Slope On West Side	10 days?	Thu 7/27/06	Wed 8/9/06
33	**Phase 4**	**22 days?**	**Tue 7/25/06**	**Wed 8/23/06**
34	Soil Nailing Operation Area "A"	15 days?	Tue 7/25/06	Mon 8/14/06
35	Stone & Fine Grade Parking Lot Behind Health Care Building	10 days?	Thu 8/10/06	Wed 8/23/06
36	Rough Grade West Side	5 days?	Thu 8/10/06	Wed 8/16/06
37	Backfill Tunnel Extension & Central Plant Foundations	5 days?	Tue 8/15/06	Mon 8/21/06
38	**Phase 5**	**60 days?**	**Tue 7/25/06**	**Mon 10/16/06**
39	Foundations Area "A"	40 days?	Tue 7/25/06	Mon 9/18/06
40	Soil Nailing Health Care Building	10 days?	Tue 8/15/06	Mon 8/28/06
41	Establish Temporary Emergency Ambulance Entrance & Contractor Storage	10 days?	Thu 8/17/06	Wed 8/30/06
42	Central Plant Underground Piping	20 days?	Tue 8/22/06	Mon 9/18/06
43	Central Plant Structure	40 days?	Tue 8/22/06	Mon 10/16/06
44	Binder & Strip Parking Lot Behind Health Care Building	10 days?	Thu 8/24/06	Wed 9/6/06
45	**Phase 6**	**140 days?**	**Tue 9/5/06**	**Mon 3/19/07**
46	Area "A" Structure	140 days?	Tue 9/5/06	Mon 3/19/07
47	Open New Main Entrance & Parking Lot Behind Health Care Building	1 day?	Wed 9/27/06	Wed 9/27/06



Project: Detailed Schedule
Date: Tue 4/7/09

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

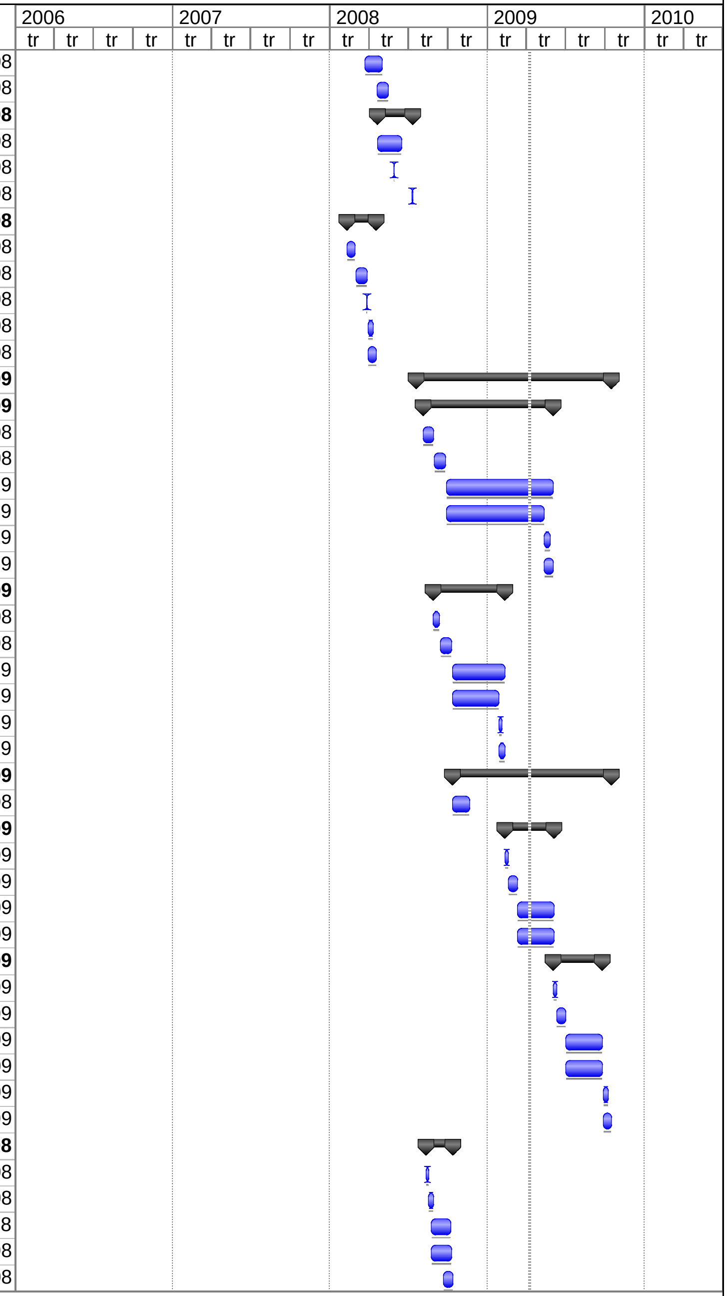
ID	Task Name	Duration	Start	Finish
48	Shut Down Existing Emergency Parking & North Entrance to Health Care Building	1 day?	Thu 9/28/06	Thu 9/28/06
49	Temporary Fencing Configuration 2	5 days?	Fri 9/29/06	Thu 10/5/06
50	Sequence 2 Demolition (Emergency & Health Care Canopies)	5 days?	Fri 10/6/06	Thu 10/12/06
51	Excavate Area "B"	10 days?	Fri 10/13/06	Thu 10/26/06
52	Extend Existing Storm & Sanitary	10 days?	Fri 10/27/06	Thu 11/9/06
53	15kV Ductbank & Re-Engergize Health Care Facility	15 days?	Fri 11/10/06	Thu 11/30/06
54	Install Retaining Wall West of Health Care Building	10 days?	Fri 12/1/06	Thu 12/14/06
55	**Phase 7**	**122 days?**	**Fri 10/27/06**	**Mon 4/16/07**
56	Soil Nailing Area "B"	15 days?	Fri 10/27/06	Thu 11/16/06
57	Central Plant Piping & Equipment Installation	100 days?	Tue 11/28/06	Mon 4/16/07
58	**Phase 8**	**147 days?**	**Fri 11/17/06**	**Mon 6/11/07**
59	Foundations Area "B"	20 days?	Fri 11/17/06	Thu 12/14/06
60	Central Plant Interior Work & Punch	40 days?	Tue 4/17/07	Mon 6/11/07
61	**Phase 9**	**216 days?**	**Fri 12/15/06**	**Fri 10/12/07**
62	Area "B" Structure	90 days?	Fri 12/15/06	Thu 4/19/07
63	Roofing Area "A"	135 days?	Mon 4/9/07	Fri 10/12/07
64	**Phase 10**	**255 days?**	**Mon 1/22/07**	**Fri 1/11/08**
65	**Exterior Envelope**	**255 days?**	**Mon 1/22/07**	**Fri 1/11/08**
66	**Exterior Studs & Dow Board**	**115 days?**	**Mon 1/22/07**	**Fri 6/29/07**
67	North Elevation	15 days?	Mon 1/22/07	Fri 2/9/07
68	East Elevation	20 days?	Mon 2/12/07	Fri 3/9/07
69	South Elevation	20 days?	Mon 3/12/07	Fri 4/6/07
70	West Elevation	20 days?	Mon 6/4/07	Fri 6/29/07
71	**Exterior Masonry**	**170 days?**	**Mon 3/5/07**	**Fri 10/26/07**
72	North Elevation	40 days?	Mon 3/5/07	Fri 4/27/07
73	East Elevation	45 days?	Mon 4/30/07	Fri 6/29/07
74	South Elevation	30 days?	Mon 7/2/07	Fri 8/10/07
75	West Elevation	55 days?	Mon 8/13/07	Fri 10/26/07
76	**Exterior Curtain Walls and Windows**	**155 days?**	**Mon 6/11/07**	**Fri 1/11/08**
77	North Elevation	15 days?	Mon 6/11/07	Fri 6/29/07
78	East Elevation	40 days?	Mon 7/2/07	Fri 8/24/07
79	South Elevation	60 days?	Mon 8/27/07	Fri 11/16/07
80	West Elevation	40 days?	Mon 11/19/07	Fri 1/11/08
81	**Phase 11**	**143 days?**	**Mon 4/30/07**	**Wed 11/14/07**
82	Area "A" MEP	85 days?	Mon 4/30/07	Fri 8/24/07
83	Roofing Area "B"	58 days?	Mon 8/27/07	Wed 11/14/07
84	**Phase 12**	**75 days?**	**Mon 8/13/07**	**Fri 11/23/07**
85	Area "B" MEP	75 days?	Mon 8/13/07	Fri 11/23/07
86	Area "A" Interior	45 days?	Mon 9/24/07	Fri 11/23/07
87	**Phase 13**	**45 days?**	**Mon 11/26/07**	**Fri 1/25/08**
88	Area "B" Interior	45 days?	Mon 11/26/07	Fri 1/25/08
89	**Phase 14**	**65 days?**	**Mon 1/7/08**	**Fri 4/4/08**
90	MEP Devices and Fixtures	45 days?	Mon 1/7/08	Fri 3/7/08
91	MEP Systems Check, Start-up, and Testing	55 days?	Mon 1/21/08	Fri 4/4/08
92	Owner Furnish and Install Equipment	45 days?	Mon 1/28/08	Fri 3/28/08
93	**Phase 15**	**45 days?**	**Mon 3/17/08**	**Fri 5/16/08**
94	Punchlist	30 days?	Mon 3/17/08	Fri 4/25/08



Project: Detailed Schedule
Date: Tue 4/7/09

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

ID	Task Name	Duration	Start	Finish
95	Final Cleaning	30 days?	Mon 3/24/08	Fri 5/2/08
96	Turn Over New Addition	20 days?	Mon 4/21/08	Fri 5/16/08
97	**Phase 16**	**59 days?**	**Tue 4/22/08**	**Sat 7/12/08**
98	Owner Move In	40 days?	Tue 4/22/08	Mon 6/16/08
99	Addition Compete	1 day?	Fri 5/30/08	Fri 5/30/08
100	Dedication Ceremony & Open House	1 day?	Fri 7/11/08	Sat 7/12/08
101	**Phase 17**	**50 days?**	**Mon 2/11/08**	**Fri 4/18/08**
102	Relocate All Construction Equipment Over to Staging Area Behind Hospital	15 days?	Mon 2/11/08	Fri 2/29/08
103	Pave Roadwork & Perking for Main Addition & Main Entrance	20 days?	Mon 3/3/08	Fri 3/28/08
104	Move Hospital Traffic Over to New Roadway	1 day?	Fri 3/28/08	Fri 3/28/08
105	Pave Parking Lot at New Emergency Drop Off	10 days?	Mon 3/31/08	Fri 4/11/08
106	Complete Islands on West & Patch Asphalt	15 days?	Mon 3/31/08	Fri 4/18/08
107	**Phase 18 - Renovations**	**325 days?**	**Mon 7/21/08**	**Fri 10/16/09**
108	**Sixth Floor**	**216 days?**	**Wed 8/6/08**	**Wed 6/3/09**
109	MGH Move Out & Abatement	18 days?	Wed 8/6/08	Fri 8/29/08
110	Demo	20 days?	Mon 9/1/08	Fri 9/26/08
111	Interiors	178 days?	Mon 9/29/08	Wed 6/3/09
112	Mechanical Systems	163 days?	Mon 9/29/08	Wed 5/13/09
113	Testing & Inspections	10 days?	Thu 5/14/09	Wed 5/27/09
114	Punchlist	15 days?	Thu 5/14/09	Wed 6/3/09
115	**Fifth Floor**	**119 days?**	**Fri 8/29/08**	**Wed 2/11/09**
116	MGH Move Out & Abatement	11 days?	Fri 8/29/08	Fri 9/12/08
117	Demo	20 days?	Mon 9/15/08	Fri 10/10/08
118	Interiors	88 days?	Mon 10/13/08	Wed 2/11/09
119	Mechanical Systems	78 days?	Mon 10/13/08	Wed 1/28/09
120	Testing & Inspections	5 days?	Thu 1/29/09	Wed 2/4/09
121	Punchlist	10 days?	Thu 1/29/09	Wed 2/11/09
122	**Fourth Floor**	**265 days?**	**Mon 10/13/08**	**Fri 10/16/09**
123	Rough-in Demo	30 days?	Mon 10/13/08	Fri 11/21/08
124	**East**	**82 days?**	**Thu 2/12/09**	**Fri 6/5/09**
125	MGH Move Out & Abatement	6 days?	Thu 2/12/09	Thu 2/19/09
126	Demo	15 days?	Fri 2/20/09	Thu 3/12/09
127	Interiors	61 days?	Fri 3/13/09	Fri 6/5/09
128	Mechanical Systems	61 days?	Fri 3/13/09	Fri 6/5/09
129	**West**	**82 days?**	**Thu 6/4/09**	**Fri 9/25/09**
130	MGH Move Out & Abatement	6 days?	Thu 6/4/09	Thu 6/11/09
131	Demo	15 days?	Fri 6/12/09	Thu 7/2/09
132	Interiors	61 days?	Fri 7/3/09	Fri 9/25/09
133	Mechanical Systems	61 days?	Fri 7/3/09	Fri 9/25/09
134	Testing & Inspections	10 days?	Mon 9/28/09	Fri 10/9/09
135	Punchlist	15 days?	Mon 9/28/09	Fri 10/16/09
136	**Third Floor**	**44 days?**	**Wed 8/13/08**	**Mon 10/13/08**
137	MGH Move Out & Abatement	4 days?	Wed 8/13/08	Mon 8/18/08
138	Demo	10 days?	Mon 8/18/08	Fri 8/29/08
139	Interiors	33 days?	Mon 8/25/08	Wed 10/8/08
140	Mechanical Systems	35 days?	Mon 8/25/08	Fri 10/10/08
141	Testing & Inspections	16 days?	Mon 9/22/08	Mon 10/13/08

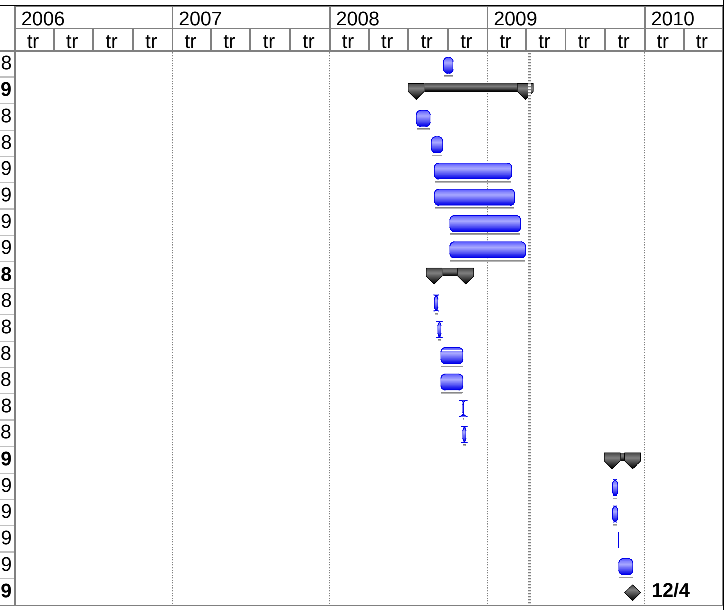


Project: Detailed Schedule
Date: Tue 4/7/09

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

Brutico

ID	Task Name	Duration	Start	Finish
142	Punchlist	16 days?	Mon 9/22/08	Mon 10/13/08
143	**Second Floor**	**181 days?**	**Mon 7/21/08**	**Mon 3/30/09**
144	MGH Move Out & Abatement	24 days?	Mon 7/21/08	Thu 8/21/08
145	Demo	20 days?	Mon 8/25/08	Fri 9/19/08
146	Interiors	129 days?	Mon 9/1/08	Thu 2/26/09
147	Mechanical Systems	134 days?	Mon 9/1/08	Thu 3/5/09
148	Testing & Inspections	118 days?	Tue 10/7/08	Thu 3/19/09
149	Punchlist	125 days?	Tue 10/7/08	Mon 3/30/09
150	**First Floor**	**53 days?**	**Mon 9/1/08**	**Wed 11/12/08**
151	MGH Move Out & Abatement	6 days?	Mon 9/1/08	Mon 9/8/08
152	Demo	5 days?	Tue 9/9/08	Mon 9/15/08
153	Interiors	37 days?	Tue 9/16/08	Wed 11/5/08
154	Mechanical Systems	37 days?	Tue 9/16/08	Wed 11/5/08
155	Testing & Inspections	2 days?	Thu 11/6/08	Fri 11/7/08
156	Punchlist	5 days?	Thu 11/6/08	Wed 11/12/08
157	**Phase 19**	**35 days?**	**Mon 10/19/09**	**Fri 12/4/09**
158	Demobilize Contractors	10 days?	Mon 10/19/09	Fri 10/30/09
159	Patch and Repair Contractor Areas	10 days?	Mon 10/19/09	Fri 10/30/09
160	Construction Complete	1 day?	Mon 11/2/09	Mon 11/2/09
161	Project Closeout	24 days?	Tue 11/3/09	Fri 12/4/09
162	**Project Complete**	**0 days**	**Fri 12/4/09**	**Fri 12/4/09**

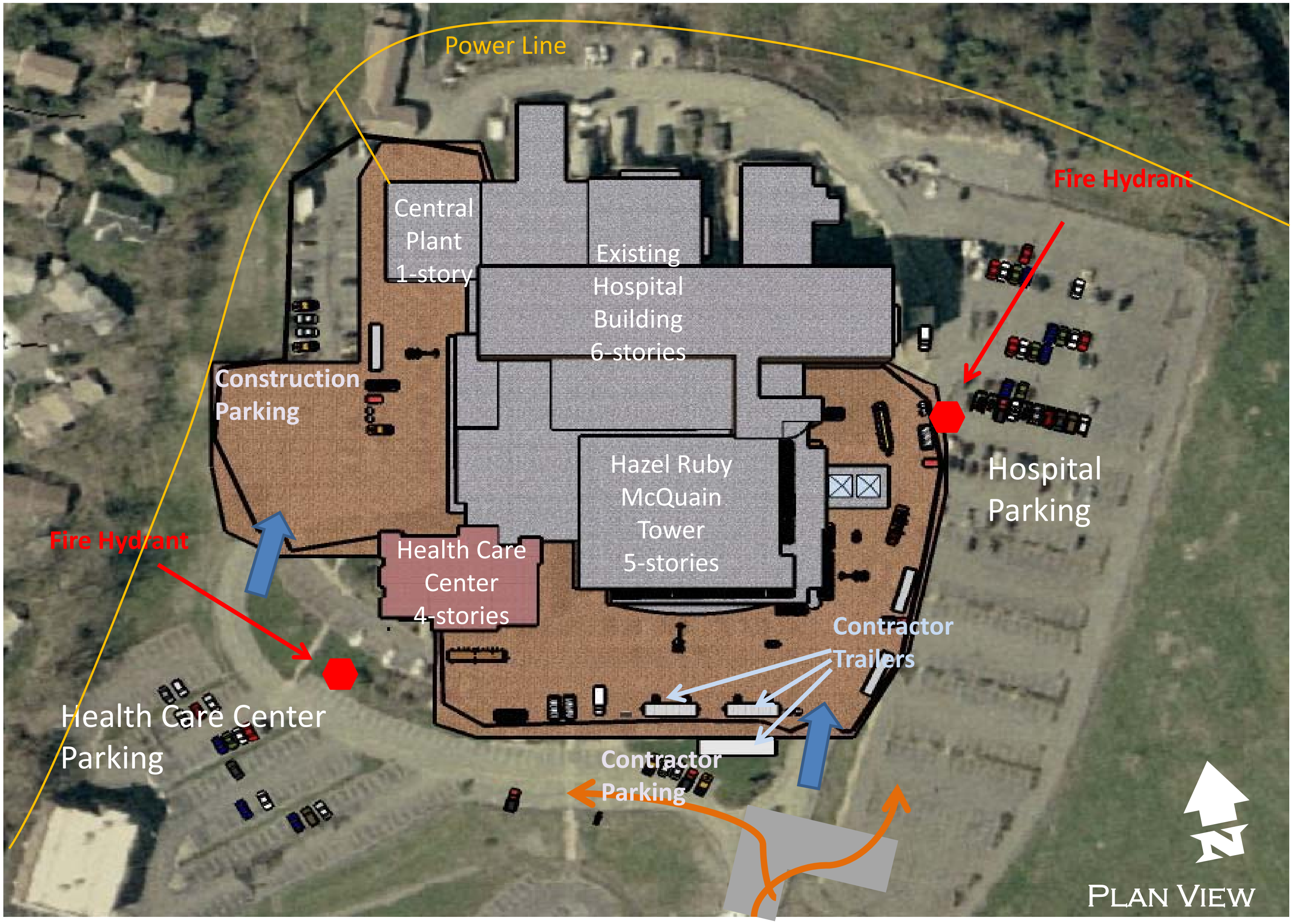


Project: Detailed Schedule
Date: Tue 4/7/09

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

Appendix B

Site Layout Plans



Legend:

Construction Entrance

Public Entrance

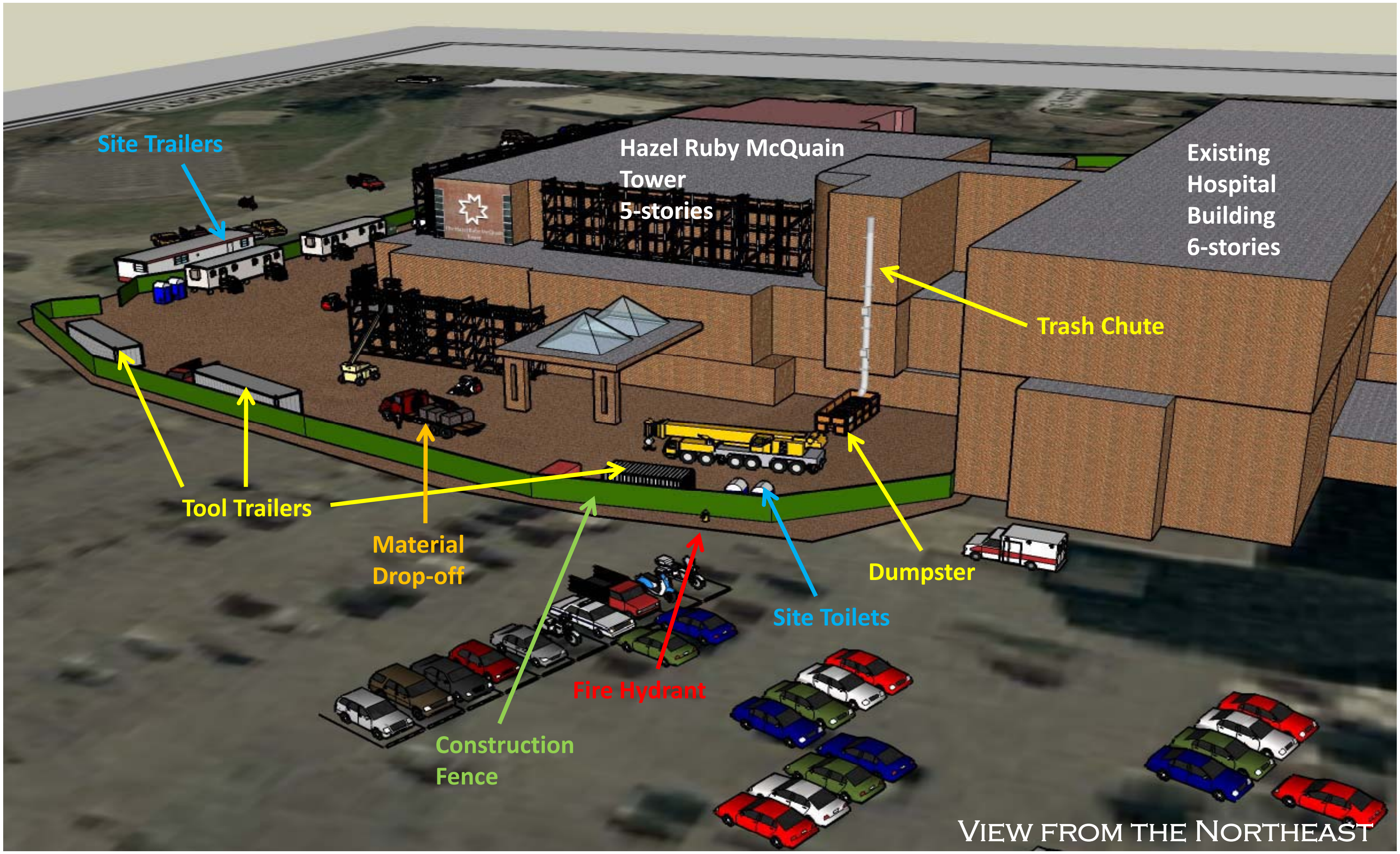
Monongalia General Hospital

Morgantown, WV

Drawing by:
Carmen A. Brutico III

Oct. 24, 2008

Construction Site Plan: Exterior Enclosures



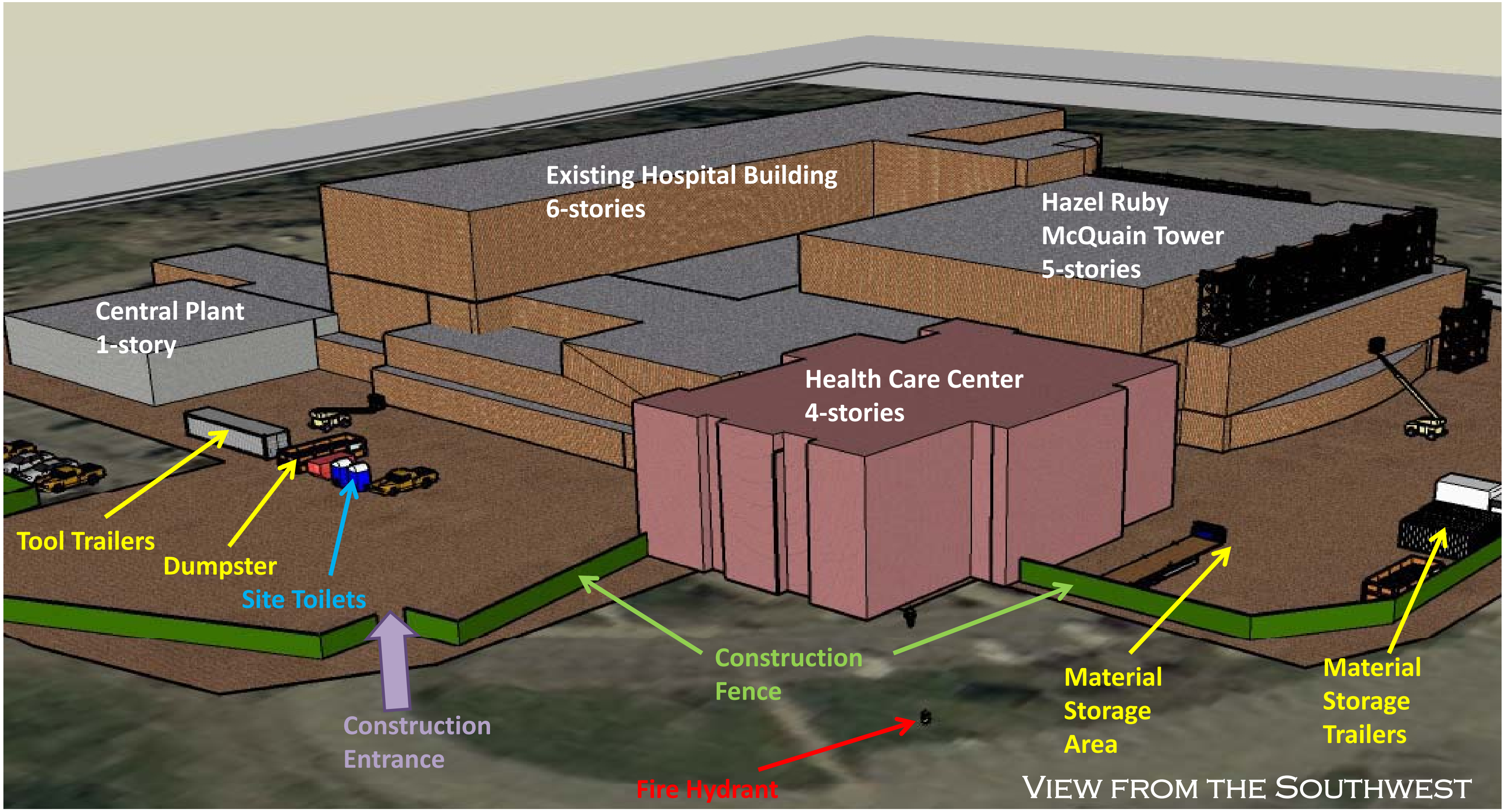
Monongalia General Hospital

Morgantown, WV

Drawing by:
Carmen A. Brutico III

Oct. 24, 2008

Construction Site Plan: Exterior Enclosures



Monongalia General Hospital
Morgantown, WV

Drawing by:
Carmen A. Brutico III

Oct. 24, 2008

Construction Site Plan: Exterior Enclosures

Appendix C

ICRA Matrix

Infection Control Risk Assessment
Matrix of Precautions for Construction & Renovation

Step One:

Using the following table, *identify* the Type of Construction Project Activity (Type A-D)

TYPE A	**Inspection and Non-Invasive Activities.** Includes, but is not limited to: ▪ removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet ▪ painting (but not sanding) ▪ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	**Small scale, short duration activities which create minimal dust** Includes, but is not limited to: ▪ installation of telephone and computer cabling ▪ access to chase spaces ▪ cutting of walls or ceiling where dust migration can be controlled.
TYPE C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies** Includes, but is not limited to: ▪ sanding of walls for painting or wall covering ▪ removal of floorcoverings, ceiling tiles and casework ▪ new wall construction ▪ minor duct work or electrical work above ceilings ▪ major cabling activities ▪ any activity which cannot be completed within a single workshift.
TYPE D	**Major demolition and construction projects** Includes, but is not limited to: ▪ activities which require consecutive work shifts ▪ requires heavy demolition or removal of a complete cabling system ▪ new construction.

Step 1: ____

Steps 1-3 Adapted with permission V Kennedy, B Barnard, St Luke Episcopal Hospital, Houston TX; C Fine CA
Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis MN
Forms modified and provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills MI 2002 Revised 2006

Step Two:
Using the following table, ***identify* the Patient Risk Groups** that will be affected.
If more than one risk group will be affected, select the higher risk group:

Low Risk	Medium Risk	High Risk	Highest Risk
▪ Office areas	▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy	▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units	▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Medical Unit ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

Step 2____

Step Three: ***Match* the**

Patient Risk Group (***Low, Medium, High, Highest***) with the planned **…**
Construction Project Type (***A, B, C, D***) on the following matrix, to find the **…**
Class of Precautions (***I, II, III or IV***) or level of infection control activities required.

Class I-IV or Color-Coded Precautions are delineated on the following page.

IC Matrix - Class of Precautions: Construction Project by Patient Risk

Patient Risk Group	Construction Project Type: TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary.

Step 3 ____

Description of Required Infection Control Precautions by <u>Class</u>

	During Construction Project	Upon Completion of Project
CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection	1. Clean work area upon completion of task.
CLASS II	1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed.	1. Wipe work surfaces with disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Upon completion, restore HVAC system where work was performed.
CLASS III	1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with disinfectant. 5. Upon completion, restore HVAC system where work was performed.
CLASS IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Dept	1. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop area with disinfectant. 6. Upon completion, restore HVAC system where work was performed.

Steps 1-3 Adapted with permission V Kennedy, B Barnard, St Luke Episcopal Hospital, Houston TX; C Fine CA
Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis MN
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Step 4. **Identify the areas surrounding the project area, assessing potential impact**

Unit Below	Unit Above	Lateral	Lateral	Behind	Front
Risk Group	Risk Group	Risk Group	Risk Group	Risk Group	Risk Group

Step 5. **Identify specific site of activity eg, patient rooms, medication room, etc.**

____

Step 6. **Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages**.

____

Step 7. **Identify containment measures, using prior assessment. What types of barriers? (Eg, solids wall barriers); Will HEPA filtration be required?**

____

(Note: Renovation/construction area shall be isolated from the occupied areas during construction and shall be negative with respect to surrounding areas)

Step 8**. Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (eg, wall, ceiling, roof)**

Step 9. **Work hours: Can or will the work be done during non-patient care hours?**

Step 10. **Do plans allow for adequate number of isolation/negative airflow rooms?**

Step 11. **Do the plans allow for the required number & type of handwashing sinks?**

Step 12. **Does the infection control staff agree with the minimum number of sinks for this project?** (Verify against AIA Guidelines for types and area)

Step 13. **Does the infection control staff agree with the plans relative to clean and soiled utility rooms?**

Step 14. **Plan to discuss the following containment issues with the project team. Eg, traffic flow, housekeeping, debris removal (how and when),**

____

____

____

Appendix: Identify and communicate the responsibility for project monitoring that includes infection control concerns and risks. The ICRA may be modified throughout the project. Revisions must be communicated to the Project Manager.

Steps 1-3 Adapted with permission V Kennedy, B Barnard, St Luke Episcopal Hospital, Houston TX; C Fine, CA
Steps 4-14 Adapted with permission Fairview University Medical Center, Minneapolis MN
Forms modified and provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills MI 2002 Revised 2006

Appendix D

ICRA Construction Permit

Infection Control Construction Permit

	Permit No:
Location of Construction:	Project Start Date:
Project Coordinator:	Estimated Duration:
Contractor Performing Work	Permit Expiration Date:
Supervisor:	Telephone:

YES	NO	CONSTRUCTION ACTIVITY	YES	NO	INFECTION CONTROL RISK GROUP
		TYPE A: Inspection, non-invasive activity			GROUP 1: Low Risk
		TYPE B: Small scale, short duration, moderate to high levels			GROUP 2: Medium Risk
		TYPE C: Activity generates moderate to high levels of dust, requires greater 1 work shift for completion			GROUP 3: Medium/High Risk
		TYPE D: Major duration and construction activities Requiring consecutive work shifts			GROUP 4: Highest Risk

CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace any ceiling tile displaced for visual inspection.	3. Minor Demolition for Remodeling
CLASS II	1. Provides active means to prevent air-borne dust from dispersing into atmosphere 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Wipe surfaces with disinfectant.	6. Contain construction waste before transport in tightly covered containers. 7. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 8. Place dust mat at entrance and exit of work area. 9. Isolate HVAC system in areas where work is being performed; restore when work completed.
CLASS III **Date** **Initial**	1. Obtain infection control permit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Do not remove barriers from work area until complete project is thoroughly cleaned by Env. Services Dept.	6. Vacuum work with HEPA filtered vacuums. 7. Wet mop with disinfectant 8. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 9. Contain construction waste before transport in tightly covered containers. 10. Cover transport receptacles or carts. Tape covering. 11. Upon completion, restore HVAC system where work was performed.
CLASS IV **Date** **Initial**	1. Obtain infection control permit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Seal holes, pipes, conduits, and punctures appropriately. 6. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site.	7. All personnel entering work site are required to wear shoe covers 8. Do not remove barriers from work area until completed project is thoroughly cleaned by the Environmental Service Dept. 9. Vacuum work area with HEPA filtered vacuums. 10. Wet mop with disinfectant. 11. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 12. Contain construction waste before transport in tightly covered containers. 13. Cover transport receptacles or carts. Tape covering. 14. Upon completion, restore HVAC system where work was performed.

Additional Requirements:	
____________ Date Initials	____________ ___Exceptions/Additions to this permit Date Initials are noted by attached memoranda
Permit Request By:	Permit Authorized By:
Date:	Date:

Appendix E

ICRA Daily Monitoring

Daily Monitoring: ILSM – ICRA Precautions

Date of assessment/survey	Assessment completed by:			
Area assessed/surveyed	Date distributed to safety/IC:			
Project no.	Project name:			
	Yes	**No**	**NA**	**List time, documentation or action/follow-up as needed**
A. EXITS				
1. Exits provide free and unobstructed egress through construction.				
2. Alternative exits are clearly identified.				
3. Means of egress in construction area inspected daily.				
4. Free & unobstructed access to ED/Services and for emergency forces.				
B. FIRE EQUIPMENT AND SAFETY				
5. .Fire alarms, detection, and suppression systems are in an operational function.				
6. Fire alarms, detection, and suppression systems are not impaired.				
7. Temporary fire alarm, detection, and suppression systems been inspected and tested monthly.				Date:
8. Training and additional fire equipment been provided for personnel.				
9. Power has been properly secured at the end of each workday.				
10. No smoking policy been implemented in and adjacent to the construction areas.				
11. Construction areas are free of storage and housekeeping materials, food waste, and debris for daily operations to reduce flammable and combustible fire load of the building; floor area leading to/from construction site cleaned daily.				Date or time:

Daily Monitoring: ILSM – ICRA Precautions

	Yes	No	NA	List time, documentation or action/follow-up as needed
12. There has been a minimum of two fire drills conducted per shift per quarter.				Date:
13. Number of hazard surveillance inspections in construction area has increased.				Last date or time:
14. Safety education programs have been conducted to ensure awareness of any ILS Safety Code deficiencies and construction hazards.				Date:
C. HAZARD SURVEILLANCE and INFECTION PREVENTION SAFETY				
15. Power is properly secured at the end of each workday.				
16. Hand and safety rails are in place and in good condition.				
17. Extension cords are grounded and in good condition.				
18. Power tools are in good condition.				
19. Workers wearing required identification and hard hats are used as required.				
20. Cutting and welding operations are properly and safely conducted and have appropriate hot work permits.				
21. Documentation of worker instruction in Right-To-Know, Infection Control and Fall hazards is available if requested.				Date of request:
22. All scaffolding complies with OSHA requirements (1926.451).				
23. Construction site secure and properly isolated from fresh air intakes.				
24. Lock out / tag out procedures are used as appropriate				

Daily Monitoring: ILSM – ICRA Precautions

	Yes	No	NA	List time, documentation or action/follow-up as needed
25. Materials used (i.e., fire retardants) comply with necessary safety regulations.				
26. Construction barriers maintain negative pressure relationships.				
27. Workers demonstrate compliance with traffic patterns.				
28. Workers comply with use of PPE (Hard hats, eye protection etc) as needed.				
29. HEPA filtration units, HEPA vacuum equipment, &/or continuous use of exhaust fans demonstrate they are functioning appropriately.				
30. Exhaust ducts sealed/capped as agreed by ICRA.				
31. Construction area doors are closed and gaskets & hardware are intact.				
32. Construction carts transporting debris are covered and consistent with agreement designed to minimize airborne particulate matter from debris.				
33. All windows and doors remain closed to prevent circulation of dust/debris.				
34. Walk-off mats, adhesive strips are clean and changed sufficiently, or construction exit cleaned sufficiently to maintain clean entry/exits.				
35. No signs of water leakage or pests.				
36. Ceiling tiles replaced when space not being accessed.				

Additional comments ____

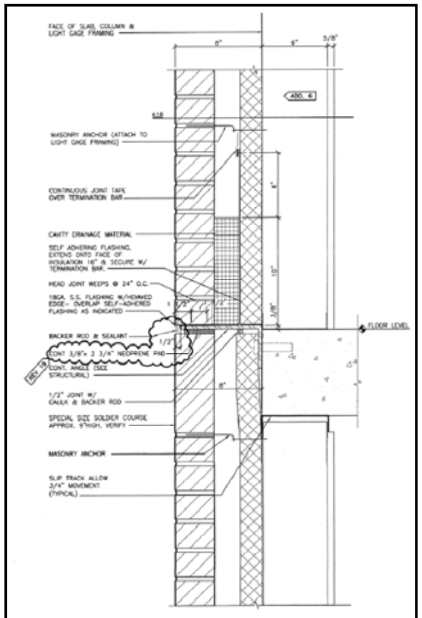
Project Manager ______________________________________ Date ______________

Contractor ____ Date ______________

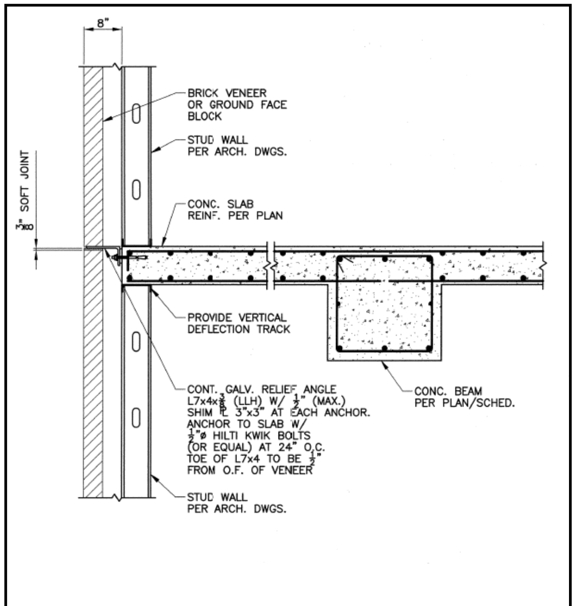
Sent to Safety &/or IC Committee _______________________ Date ______________

Appendix F

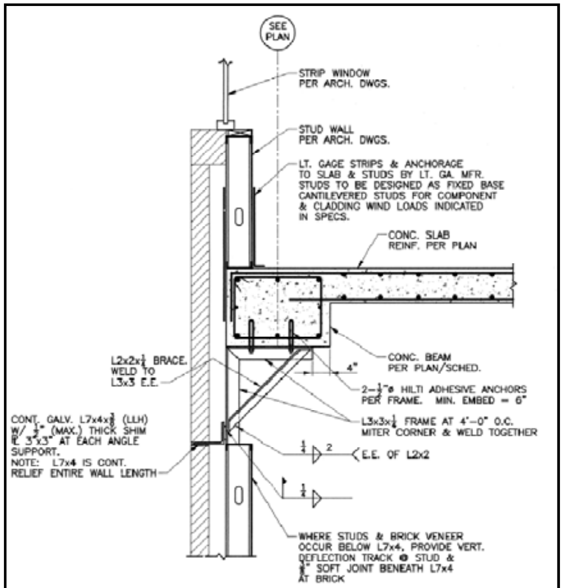
Exterior Wall Sections



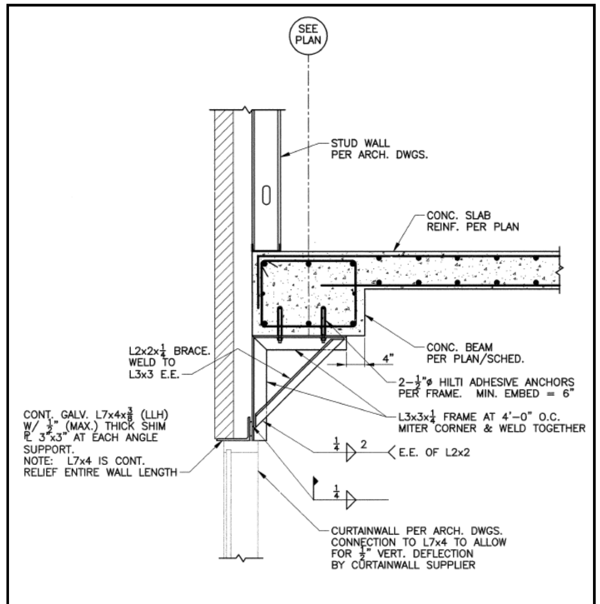
B TYPICAL FLOOR SECTION DETAIL



SECTION 220
SCALE: 3/4" = 1'-0" S6.1



SECTION 219
SCALE: 3/4" = 1'-0" S6.1



SECTION 223
SCALE: 3/4" = 1'-0" S6.1