SAINT VINCENT HEALTH CENTER

Tyler Jaggi
CM Option

Senior Thesis Final Report

Advisor: Dr. David Riley

April 7rd, 2011

Saint Vincent Health Center

Infill Building

Erie, PA

General Building Data

Building Name :	Saint Vincent Health Center
Location :	Erie, PA
Occupancy Type:	Medical
Gross Building Area :	104,660 SF
Number Of Stories :	3 (1 below ground)
Total Building Cost:	Approx. $ 45 Mil.
Dates of Construction:	7/10/2010 – 11/1/2011 (Estimated)
Project Delivery Method:	Construction Management

Architectural / Structural

Façade

- Most will be 8" CMU with rigid insulation & a 2"stone veneer. Some places will be aluminum siding panels, and some brick veneer to match the adjacent Harder Building.

Roofing

- Composed of W18x35 & W10x12 beams, W24x55 & W18x40 Girders. The roof structure will be steel composite decking with a concrete floor/roof. On top of the concrete there will be tapered roof insulation and an EPDM membrane roof.

Structure

- 3 total levels (1 below ground). The structural system consists of a steel frame structure supported by deep foundations. Floors are framed with a 4" concrete slab on a 2" composite steel metal deck Steel beams and girders carry gravity loads to steel columns supported on concrete caissons.

Project Team

Owner:	Saint Vincent Health Center
Architect:	Rectenwald Architects, Inc.
Structural Engineer:	Atlantic Engineering Service
Mechanical Engineer:	Karpinski Engineering
Electrical Engineer:	Karpinski Engineering
Civil Engineer:	Urban Engineers
Construction Manager:	E.E. Austin, Inc.
Phase 1 Concrete:	Perry Construction Group
Site Utilities:	Wm T. Spaeder Co.
Phase 1 Caissons:	G.M. McCrossin

Mechanical System

Central Plant (lower Level)

- The new boiler plant will serve the existing hospital and future expansions. The control system will be an automated system.
- The Steam system with include (5) 350hp boilers with the space to add two additional 350hp boilers. The heating/reheat system will be served by two variable speed, based mounted, pumps, one pump will run while the other remains standby.

Chilled water system:

- This new chiller plant will serve this addition & future additions. The chiller plant will have (2) 750 ton centrifugal chillers/pumps with space for one additional 750 ton chiller. There will be a new two cell cooling tower on the new ground floor roof.

Electrical System

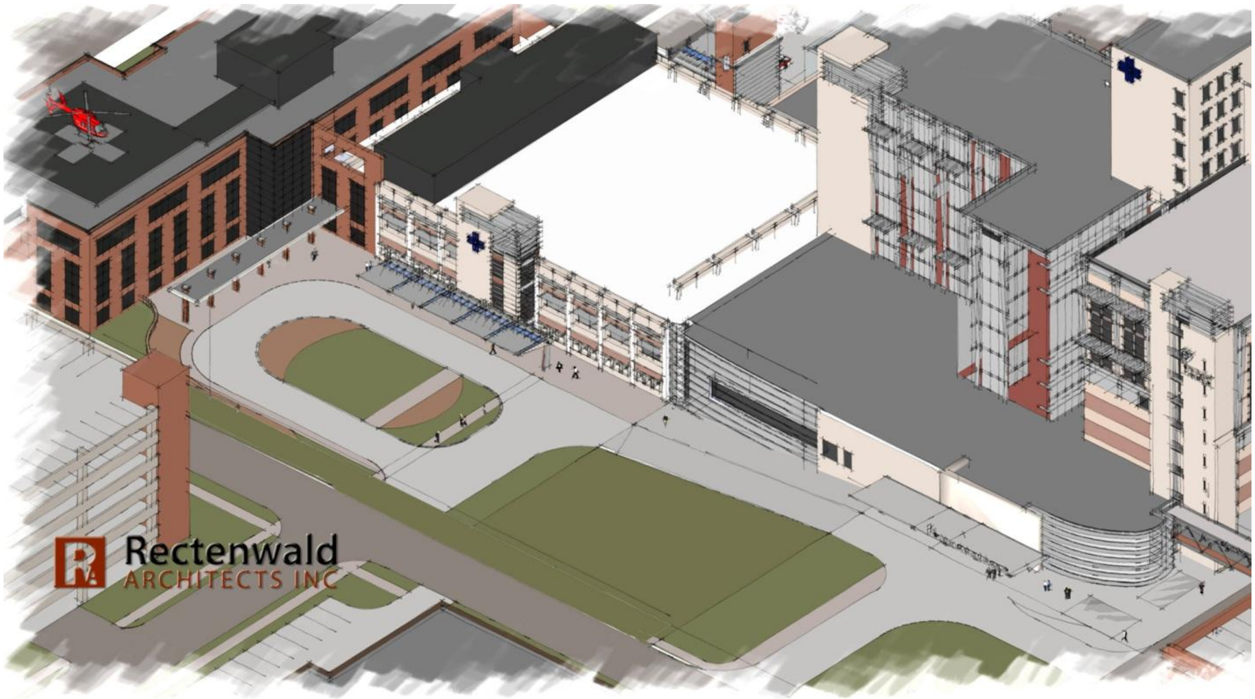
The existing hospital is served by two 36KV primary services and two 5MVA transformers. A single 4160V feeder will be serve a medium voltage load interrupter switchgear lineup located in the lower level of the addition. Emergency Power for the Hospital – The new addition shall include two new 1000KW generators and new paralleling switchgear. The parallel switchgear was sized to include the addition of one future 1000KW generator.

Tyler Jaggi Construction Option

http://www.engr.psu.edu/ae/thesis/portfolios/2011/tsj111/index.html

TABLE OF CONTENTS:

SAINT VINCENT
INFILL BUILDING



Executive Summary

Senior Thesis Final Report is intended to discuss the four analyses that could be performed on the Saint Vincent Health Center Addition. Each topic is centered on the central theme of improving efficiency in the construction industry: schedule reduction, efficiency, prefabrication efficiency

ANALYSIS #1: Schedule Reduction from Re-sequencing Construction Phases

The proposed sequence has multiple phases with demolition work overlapping new construction activities throughout the entire project schedule. Phased occupancies are planned for the Emergency entrance, connecting corridor and In-Fill Addition and the Existing Hospital to accommodate Saint Vincent's requirements. Ultimately, the overall project schedule starts with work on the new entrance for the emergency department and ends with the construction of the In-Fill Building, along with temporary construction and demolition in between.

The in-depth re-structuring of the project schedule and phasing can reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. The best way to accelerate the schedule would be by working on two phases simultaneously. This could be done during phase 1 and 2. By starting construction on the temporary corridor (Phase2) during the construction of the new emergency entrance (Phase 1). This would save approximately 3 months in the schedule if Phase 1 and 2 were being worked on simultaneously.

The savings that could happen if this project finished several weeks ahead of schedule could help Saint Vincent as well as the project team. Things such as utilities and rented equipment can be returned earlier, which saves money. Another large savings is the personal savings of not having project managers, engineers and superintendents on the project any longer. They can move on to the next job. Above are the tables showing the estimated savings from finishing the project 13 weeks early. The savings for General conditions are around $32,300, and the savings of personal on the project can be up to $110,000. Saint Vincent could also start using the new patient and operating rooms. By doing this, it will create a huge revenue estimated anywhere around a few hundred thousand.

I recommend that Saint Vincent and the project team take these actions and work on phase 1 and 2 simultaneously. Although there will be a need for more quality workers, and the site will be more congested, I still think this is something worth doing. Reducing the schedule by 13 weeks and saving thousands of dollars makes it worth it for project.

ANALYSIS #2: Comparing Façade Systems: Hand laid masonry vs. Precast Architectural Panals

The proposed façade is currently a combination of many different materials including brick, stone, a curtain wall, and metal panels: white and stainless steel. The details for all of these connections are very time consuming and difficult to comprehends. Simplifying the façade to just one system would allow for less details and more consistency allowing the construction to run more smoothly. The materials would need to be researched to see if there are alternatives that have easier connections. The materials also need to have similar properties to perform the same. Precast masonry is also a possibility to decrease construction time and site congestion. This analysis will be including a portion of the structural breadth by analyzing and designing additional supports and connections.

Implementing the alternative SlenderWall architectural precast concrete and steel stud panel wall system in lieu of the hand laid brick system would be a beneficial change to the exterior façade. The SlenderWall system allows the building skin schedule to be reduced by 20 days and begin after the superstructure is completed. When compared to the original schedule with the hand laid brick, which starts while the second floor slab is still being poured, the alternative SlenderWall system will greatly decrease site congestion during the superstructure phase. Also, the decision to use the SlenderWall system has been determined to reduce upfront costs by $15,394 when compared to using hand-laid brick.

The Saint Vincent Heath Center Project Team do like keeping jobs in the area so that might be a reason why hand-laid masonry was used. Plus this would give more work for EE Austin and their carpenters. Because the overall schedule of the project isn't effected by the reduction in exterior enclosure, Saint Vincent and the project team might think the same savings that could save using SlenderWalls is NOT worth losing work with the locals. Local construction is the backbone of Erie and in an area of little construction work, it is necessary to keep as much of that work for local contractors. Ultimately, the decision is up to Saint Vincent and the project team. I think they should keep the original plan and use hand-laid mansory.

ANALYSIS #3: Develop an Infection Control Risk Assessment (ICRA) Plan

There are many considerations in the design and construction or renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff. Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces. The precaution class needed for this project is from a matrix that says this construction project with Saint Vincent is a type IV patient risk. These pre-cautions required are listed in this section. Mechanical breadth calculations are also in the analysis.

ACKNOWLEDGMENTS

Academic Acknowledgments:

Penn State AE Faculty

Dr. David Riley – CM Advisor

Industry Acknowledgments:

EE AUSTIN & SON INC
Contractors & Construction Managers • Since 1906

karpinski
ENGINEERING

50 URBAN ENGINEERS
1960-2010 Formulating Excellence

Special Thanks To:

Saint Vincent Health Center

EE Austin's Project Team

Saint Vincent Project Team

PACE Industry Members

My Family and Friends

Project Overview

Owner / Client – Saint Vincent Health System

History - Founded by the Sisters of Saint Joseph in 1875, Saint Vincent Health Center is the Erie area's first hospital. Saint Vincent has evolved into an integrated Health System, providing patients with an outpatient network spread across the entire region. Saint Vincent remains a member of the Erie community, and continues to provide a continuum of services to fit your health care needs. Over the next 130 years, the original building was expanded, other buildings were constructed and the health center "campus" was formed. Saint Vincent Health System grew to encompass sites such as other health care facilities and physician practices that are in the regional community.

Purpose of building - Saint Vincent is building the new Infill Building to expand and upgrade their Emergency Department and Operating Rooms. In the basement of the new building they are putting in a new Central MEP Plant that will replace the entire MEP services for the entire complex of buildings.

General Building Data:

- Building Name : Saint Vincent Health Center
- Location : Erie, PA
- Occupancy Type: Medical
- Gross Building Area : 104,660 SF
- Number Of Stories : 3 (1 below ground)
- Total Building Cost: Approx. $ 45 Mil.
- Project Delivery Method: Construction Management

Scheduling / Sequencing – This is a three phase project: Phase I is new Ambulance Entrance Addition. Phase II is Temporary connector corridor along the west side of the site so the existing connector can be removed to allow for access to the new building. Phase III is the new inlet building itself. With three phases, a lot of coordination must be done to not fall behind schedule.

A critical sequencing issue is not to interrupt flow of hospital operations at ED and movement between the existing hospital and the MOB (Medical Office Building / Hardner Building) to the North.

Phase Occupancy – The new emergency ambulance entrance (Phase I) is being constructed now so until it is complete, ambulances and patients will continue to use the existing emergency department entrance off of 24th Street. During Phase II, when Phase I is all complete, all ED traffic (patients and ambulances) will use the new Ambulance Entrance for access to the Emergency Department (ED), down the connector corridor. During Phase III, after the temporary connector on the west side is complete at the end of Phase II, pedestrian ED traffic will use the entrance at the southwest corner of that new temporary connector. Ambulance traffic will continue using the new Ambulance Entrance.

Code:

The codes being used are IBC as enforced by local jurisdiction (B.I.U.) and FGI Guidelines for design and construction of Health Care Facilities and NFPA as required by the State Department of Health (D.O.H.)

Zoning:

Zoning is RLB by the City of Erie

Building Envelope & Façade:

The Specifics on the shell construction is still being developed

Building might have a brick façade that matches existing hospital & might have some glass curtain wall

Roofing system:

The Roofing system of the Saint Vincent Medical Center Infill Building is composed of W18x35 & W10x12 beams, W24x55 & W18x40 Girders. The roof structure will be steel composite decking with a concrete roof. This roof is designed to be the possible 3rd floor in the future, with columns of the existing structure sized for the expansion of 3 additional floors in the future.

Sustainability Features:

LEED Silver rating.

Structural structure is designed with the possible 3 floors addition in the future. New columns would line up with the existing column below them.

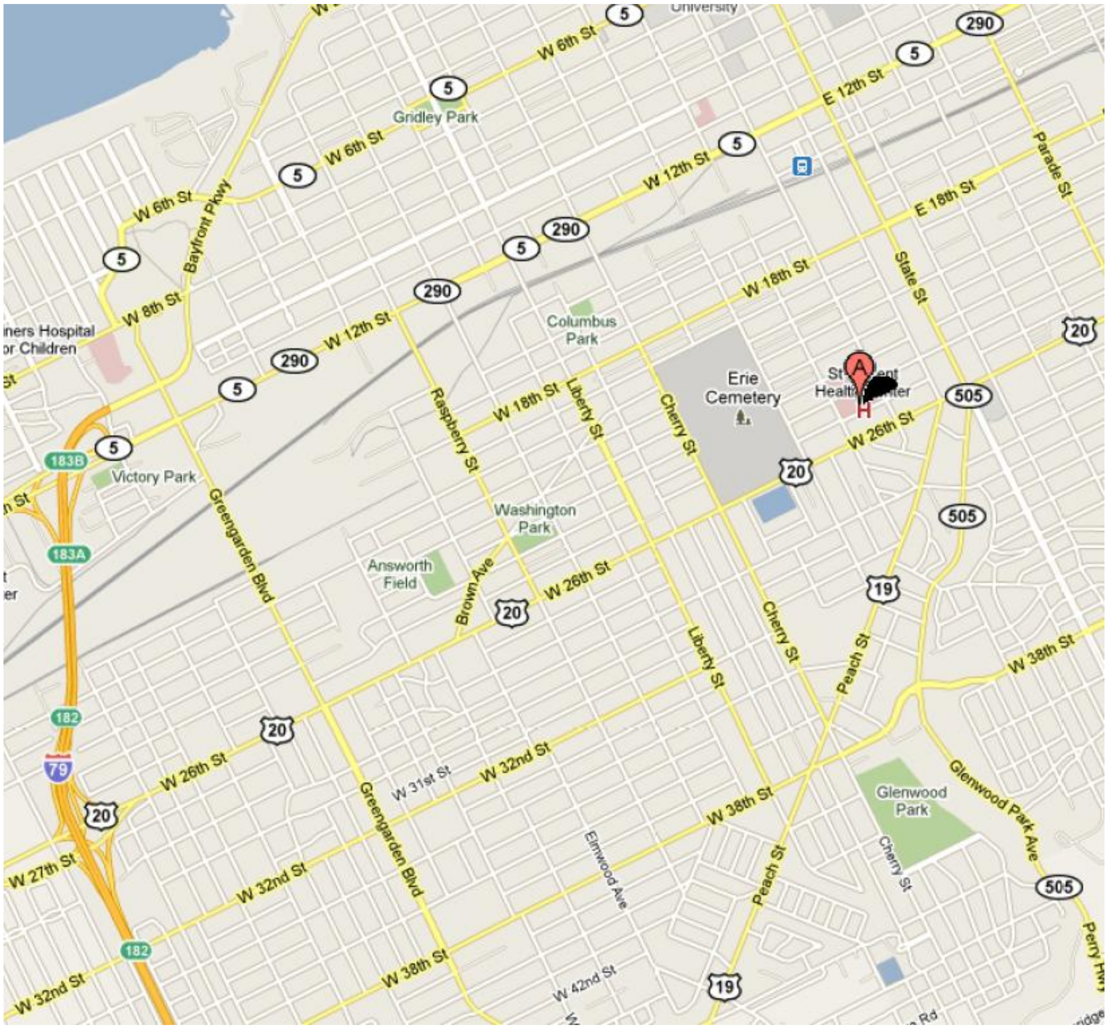
Project Location

Erie, PA

Surroundings – Downtown Erie, one block from Route 20 (W. 26th St.). Site is two miles away from Interstate 79.

Traffic/Roads – Site surrounded by four roads (West 23th & 25rd Streets, Sassafras St. and Myrtle St.) The Site is only a few miles from Interstate 79 & 90. Site is also close to Lake Erie.

Site access – Phase II site access will be from Myrtle Street (West side of site).



Existing Civil conditions – There have been numerous unforeseen underground utility conflicts: existing water lines being deeper than shown on drawings and conflicting with new storm sewer lines, existing sanitary sewer lines being in a different location than anticipated and running through a grade beam and finding an electrical duct bank that was not shown on any existing drawings.

Weather / Climate - The climate of Erie is typical of the Great Lakes. Erie is located in the Snow Belt. Erie's winters are typically cold, with heavy lake effect snow, but also with occasional stretches of mild weather that causes accumulated snow to melt. Erie lies in the humid continental zone. The city experiences a full range of weather events, including snow, ice, rain, thunderstorms and fog. Erie is 13th on the list of snowiest places in the United States, averaging 88 inches per year. With all this snow in the winter months, the schedule should be adjusted for this because of loss of work time, delays, and work inefficiency due to cold and snowy weather. Snow removal should also be considered in the schedule and cost estimate.

Climate data for Erie International Airport

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F	73	75	82	89	91	100	99	96	99	89	82	75	100
Average high °F	33.5	35.4	44.7	55.6	67.4	76.2	80.4	79.0	72.0	61.0	49.3	39.6	57.8
Daily mean °F	26.9	28.2	36.5	46.8	58.1	67.4	72.1	70.9	64.0	53.3	42.9	32.7	49.9
Average low °F	20.3	20.9	28.2	37.9	48.7	58.5	63.7	62.7	55.9	45.5	36.4	26.8	42.1
Record low °F	-18	-16	-9	7	26	32	44	37	33	23	6	-11	-18
Rainfall inches	2.53	2.28	3.13	3.38	3.34	4.28	3.28	4.21	4.73	3.92	3.96	3.73	42.77
Snowfall inches	26.3	17.3	11.2	2.3	Trace	0.0	0.0	0.0	0.0	0.3	9.0	25.3	91.7
Record high °C	22.8	23.9	27.8	31.7	32.8	37.8	37.2	35.6	37.2	31.7	27.8	23.9	37.8
Average high °C	0.83	1.89	7.06	13.11	19.67	24.56	26.89	26.11	22.22	16.11	9.61	4.22	14.33
Daily Mean °C	-2.83	-2.11	2.5	8.22	14.5	19.67	22.28	21.61	17.78	11.83	6.06	0.39	9.94
Average low °C	-6.5	-6.17	-2.11	3.28	9.28	14.72	17.61	17.06	13.28	7.5	2.44	-2.89	5.61
Record low °C	-27.8	-26.7	-22.8	-13.9	-3.3	0	6.7	2.8	0.6	-5	-14.4	-23.9	-27.8
Rainfall mm	64.3	57.9	79.5	85.9	84.8	108.7	83.3	106.9	120.1	99.6	100.6	94.7	1,086.4
Snowfall cm	66.8	43.9	28.4	5.8	Trace	0	0	0	0	0.8	22.9	64.3	232.9

Project Delivery System

Appendix A: Sub and supplier list attached for each of the trades in phase I. The phase II portion will not be out to bid until mid-October. All prime bids were submitted to the architect's office and opened privately. Awards were based on price scope and value. All contracts/P.O.'s are written through the Construction Manager. (EE Austin).

The structure of the organizational chart shows that a solid blue line denotes a legal contract that binds the two parties. This is the case for all of the subcontractors with regard to EE Austin, the construction manager. Saint Vincent Health Center has contracts between the architect, construction manager and engineers; however, there is no legal tie between the parties. EE Austin is the CM-At-Risk, owner representative. The contract between Saint Vincent and Austin is cost of construction, plus % fee.

APPENDIX A

Project Delivery System

Staffing and Contracts

&

Organization Chart

Appendix A

9/28/2010

Saint Vincent Health Center Infill Building

Contract Details

Role	Firm	Contact	Contract Type	Selection Process	Bonds Required	Insurance Required
Owner	Saint Vincent Health Center	Paul Matters				BR
Contract with **Architect**	Rectenwald Architects	Ken Hartsfield, A.I.A.	AIA B101, Lump Sum Fee for Services	Already contracted for master planning, continued contract to this project	?	WC, GL, PL
Contract with **Structural Engineer**	Atlantic Engineering Service	Andrew Verrengia, P.E.	?		?	WC, GL, PL
Mechanical Engineer	Karpinski Engineering	Ray Hoon, P.E.	?		?	WC, GL, PL
Electrical Engineer	Karpinski Engineering	Jim Cicero, P.E.	?		?	WC, GL, PL
Civil Engineer	Urban Engineers	John Morris	?		?	WC, GL, PL
ED Consultant	Lennon Associates	?	?		?	?
OR Consultant	Frank Zilm	Frank Zilm	?		?	?
Structural Steel	Amthor Steel	Terry Carrera	Lump Sum	Negotiated to place steel mill order	?	WC, GL, A, U
Construction Manager	E.E. Austin & Son, Inc.	Chuck Jenkins	Construction Management, Cost of Construction + % Fee	Proposal, interview, presentation	Payment & Performance Bond	WC, GL, A, U
Contract with **Ph. 1 Concrete Contractor**	Perry Construction	Rob Doyle	Lump Sum	Lowest Qualified Competetive Bid (LQCB)	None	WC, GL, A, U
Ph. 1 Site Utilities	Wm T. Spaeder	Steve Spaeder	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Earthwork, Flatwork, General Trades	E.E. Austin & Son, Inc.	Ken Sherwin	Lump Sum (T&M for Earthwork)	LQCB	None	WC, GL, A, U
Ph. 1 Caissons, Shoring	G.M. McCrossin	Russell Kohler	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Masonry	R. Moran Co.	Rick Moran	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Roofing	*Not selected yet*		Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Studs, Drywall, Acoustical	RAM Acoustical Corp.	Daryl Pitzer	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Tile & Terrazo	DeSpirt Mosaic & Marble Co.	Bill Buscaglia	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Painting	Beals-McMahon	Mickey McMahon	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Sprinkler Contractor	Sandberg Fire Protection	Rich Olson	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Plumbing Contractor	Scobell Co.	Mark Klimow	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 HVAC Contractor	Wm T. Spaeder	Steve Spaeder	Lump Sum	LQCB	None	WC, GL, A, U
Ph. 1 Electrical	Church & Murdock Electric	Jess Murdock	Lump Sum	LQCB	None	WC, GL, A, U

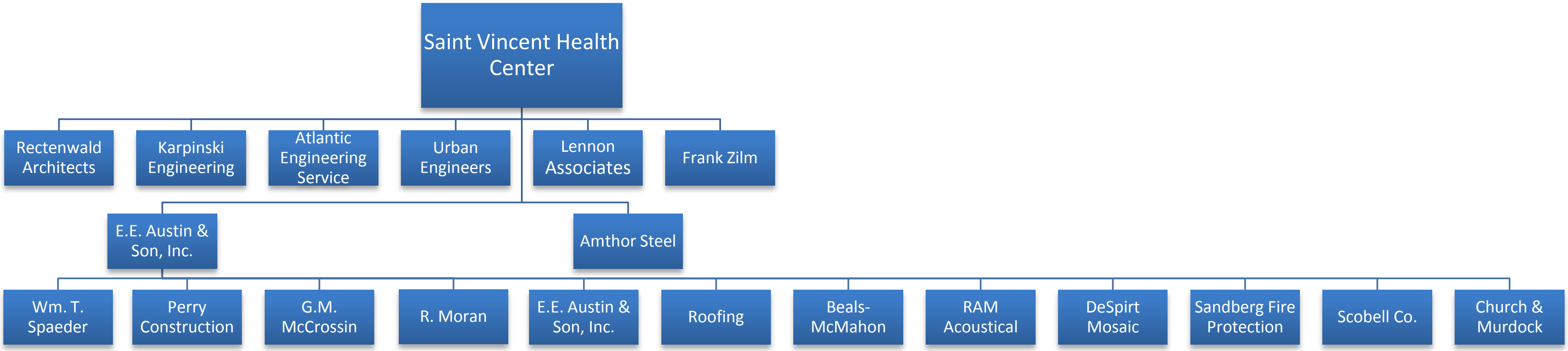
Insurance Key

BR - Builders' Risk
WC - Worker's Compensation & Employer Liability
GL - Commercial General Liability
PL - Professional Liability (Errors & Omissions)
A - Automotive
U - Commercial Umbrella

Appendix A

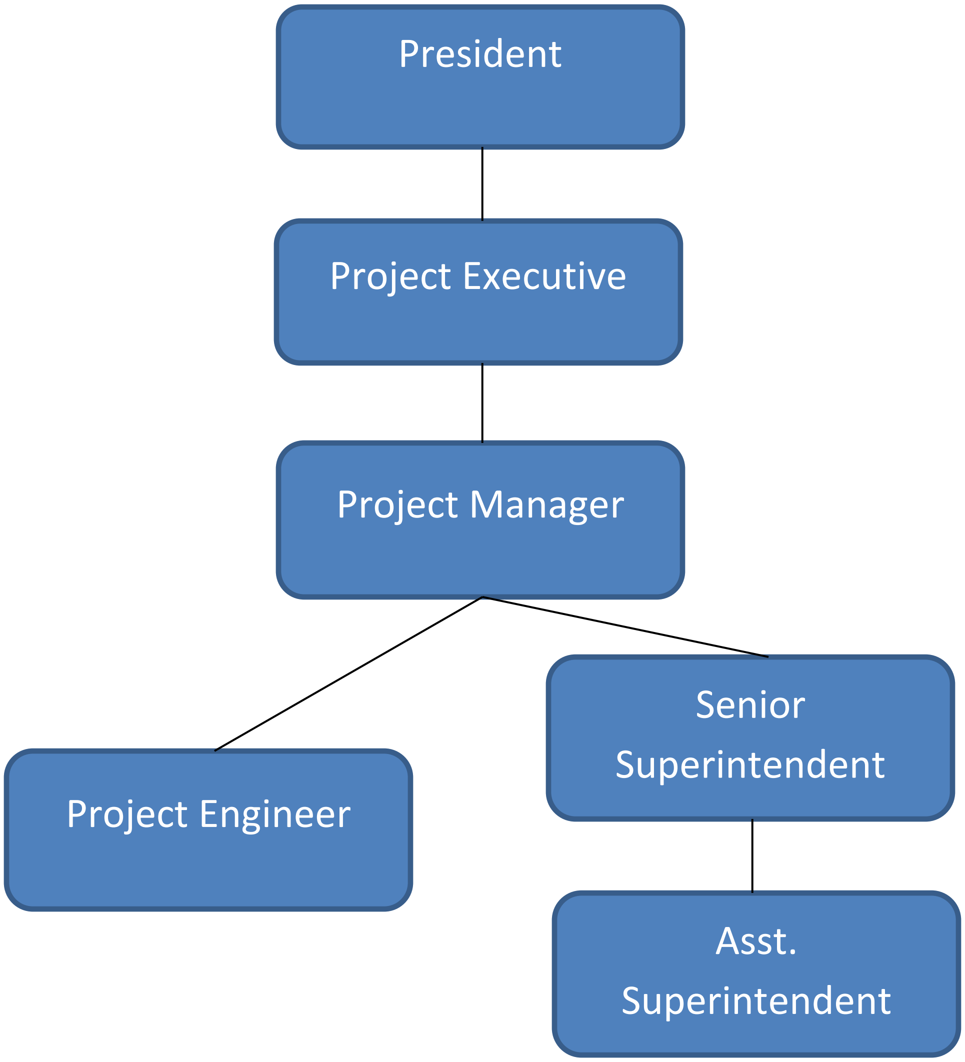
Saint Vincent Health Center Infill Building Organization Chart

9/27/2010



Only Phase 1 Contracts with Construction Manager E.E. Austin & Son, Inc. shown

Staffing Plan



EE Austin (CM) - Staffing Plan

Saint Vincent Project Staff Requirements:

Architect (3), Owner (3), MEP Engineer (3), Civil Engineer (2), Safety Manager (1), Construction Manager (4), Superintendent (1), Asst. Superintendent (1), Perry(6), Spaeder (6) Mayer Bros(Excavation, backfill & trucking with EEA) (6), Masons(5), EEA General Trades (2)

E.E. Austin & Son staffing plan for their company on this project looks as shown in the above figure. It includes a President, Project Executive, Project Manager, Project Engineer, Superintendent and an Asst. Superintendent. The lines on the figure show the relationship of who reports to whom. The Project Executive takes care of the administrative items. The Project Engineer is in charge of the typical engineering functions and the Project Manager is in charge of RFI's and submittals. The superintendents are responsible for different field duties.

On this project, the management staff (P, PE, PM, PE) is located at the home office, which is just a few minutes away. The field staff (superintendents and carpenters) is stationed at the jobsite in the existing adjacent building. Typically, the management staff visits the site 2-3 times a week for progress meetings, safety inspections and conflict resolution.

Site Plan

The site plan along with phasing diagrams for Phases I, II &III are in **Appendix B**

The site for the Saint Vincent Health Center Addition is located between two existing hospital structures. The Hardner Building, located north of the site, is the Medical Office Building for Saint Vincent. The Existing Hospital building is also constricting the site for the new Infill building between the Hardner and existing hospital building. The new addition is designed to connect the two existing buildings, add additional operating and patient rooms along with replacing the central plant for the MEP services for the entire complex.

The property line is the whole block of the Saint Vincent complex. The boundaries of construction are the fenced in area by the site work access on 23th Street. There are no field office trailers on site because of the importance of space to work. Saint Vincent has generously made room for everyone's field office space in the existing Hardner building (electric and utilities included). There are no temporary utilities that are provided by the CM, all is done by Saint Vincent and the existing buildings surrounding the site. There is a dumpster pick-up near the site access on 23rd Street there is little area for material laydown. Materials and equipment are held in warehouses, if possible, until they are needed.

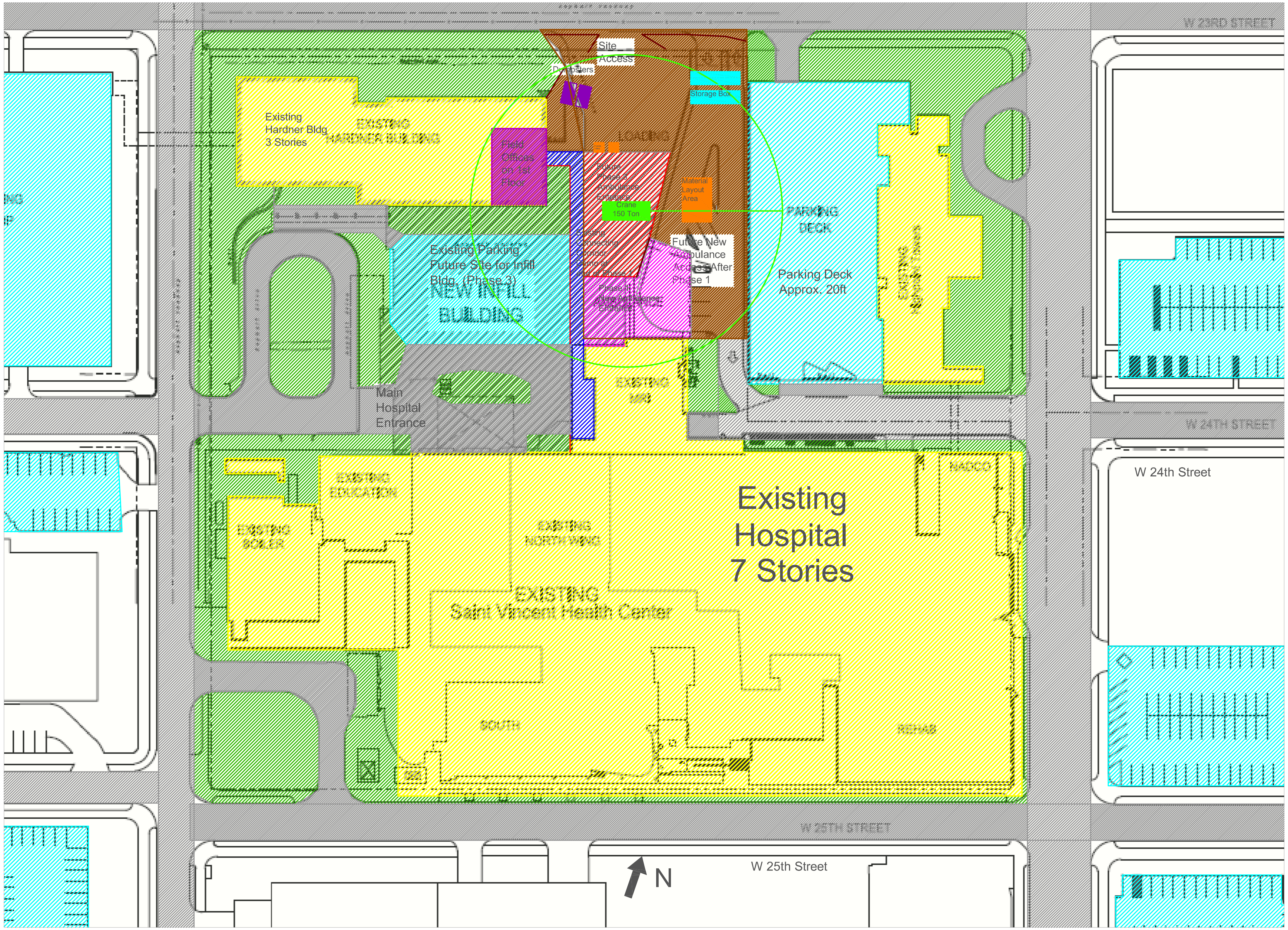
There are multiple places to park all around the complex for worker parking. Patient walk patterns will not be able to be on site because of the new temporary connecting corridor, which will block the front of the hospital from the construction work. The only place where pedestrian patterns could be a concern is on 23rd Street. The site is fenced off from pedestrians, but with trucks and equipment leaving and entering the site will have to watch out for other cars, although this street usually is not busy. Workers need to be cautious of pedestrians walking on the sidewalk.

During Phase I, the construction will be restricted to the Entrance for the Emergency department. All hospital traffic will be through the main entrance. A mobile 150 Ton crane will be used when erecting steel for both Phase I & III. When Phase I is complete and the new emergency entrance is ready for use construction for Phase II will began. Phase II deals with the construction of the temporary connecting corridor between main hospital and the Hardner building. Both the main and new emergency entrance will be open for use. Once the new temporary connecting corridor is complete, demolishing of the existing corridor will happen which will allow access to the site of the new In-fill addition building. Starting Phase III will start with demo existing parking lot, and began the deep foundation system. After that and the whole substructure is complete, the project will complete the 3-story building inside and out. The plans for this building are not designed past the exterior enclosure.

APPENDIX B

Site Plans for Phases 1, 2 & 3

Appendix B

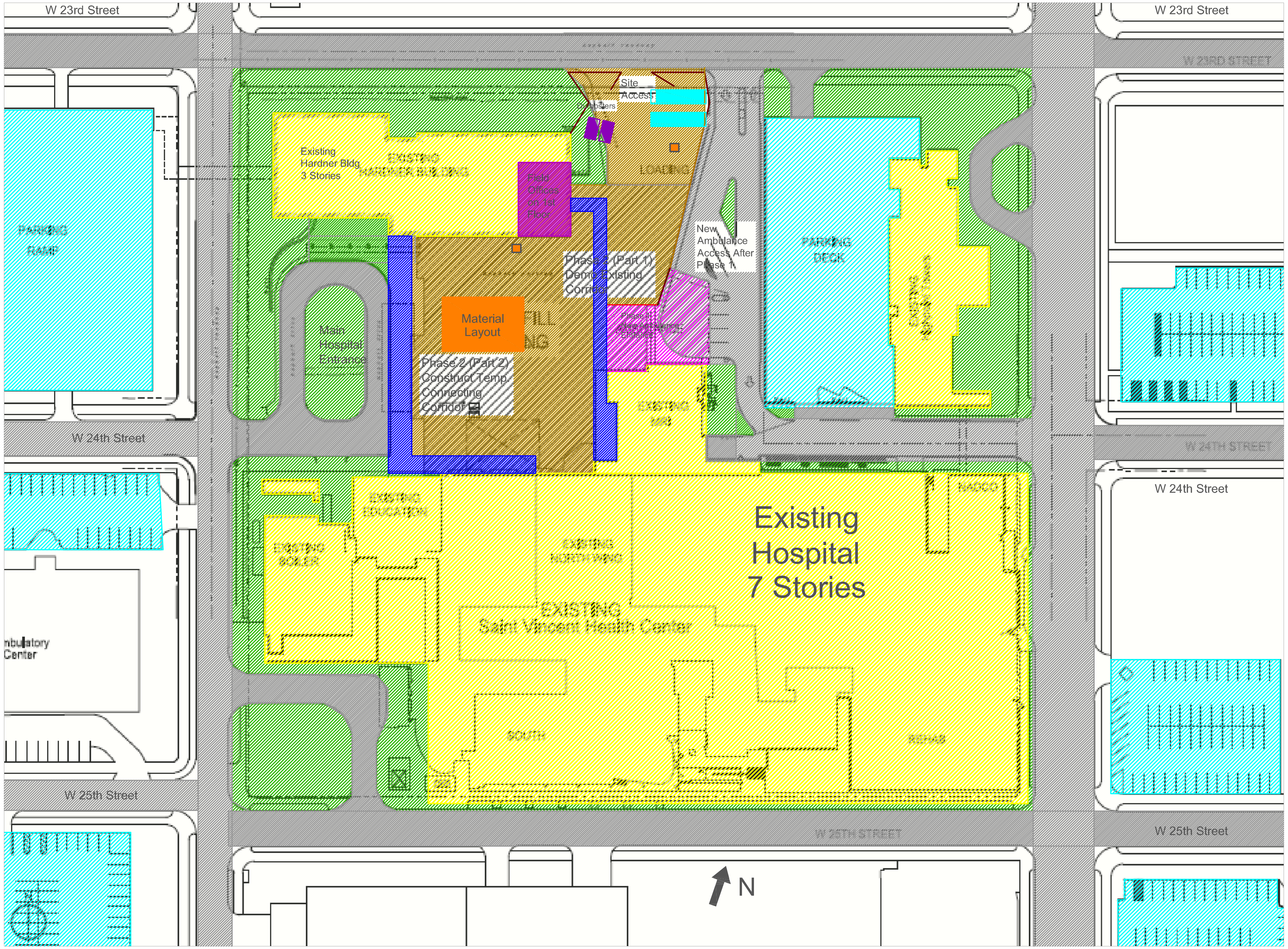


Legend

🟨	Existing Bldgs
🟫	Site Work Area
🟦	Parking
🟩	Grass
⬜	Paving
🟪	Phase 1 Work
🟦	Phase 2 Work (Existing Corridor)
🟥	Phase 3 Future Work
🟩	150 Ton Crane
🟦	Storage Box/Shed
🟧	Portable Toilets
🟪	Dumpsters

Tyler Jaggi -CM 10/25/10	Phase 1 - Emergency Entrance Saint Vincent Health Center	SP101

Appendix B

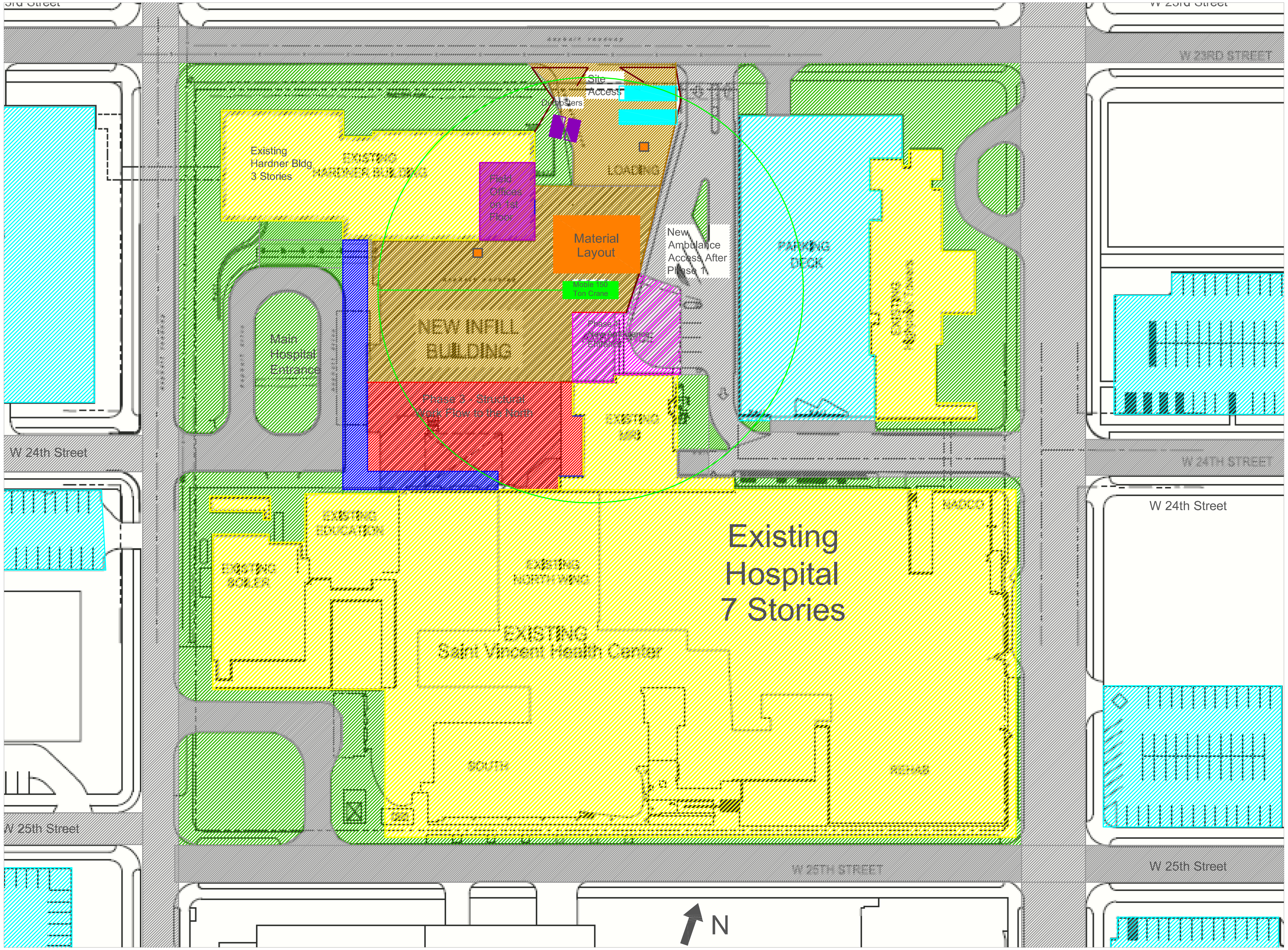


Legend

- 🟨 Existing Buildings
- 🟫 Site Work Area
- 🟦 Parking
- 🟩 Grass
- ⬜ Paving
- 🟪 Phase 1 Work Completed
- 🟧 Portable Toilets
- 🟪 Dumpsters
- 🟦 Storage Box/sheds
- 🟧 Material Layout
- 🟦 Phase 2 Work

Tyler Jaggi - CM 10/25/10	Phase 2 - Demo Exist. Corridor/ Constr. New Temporary Corridor Saint Vincent Health Center	SP102

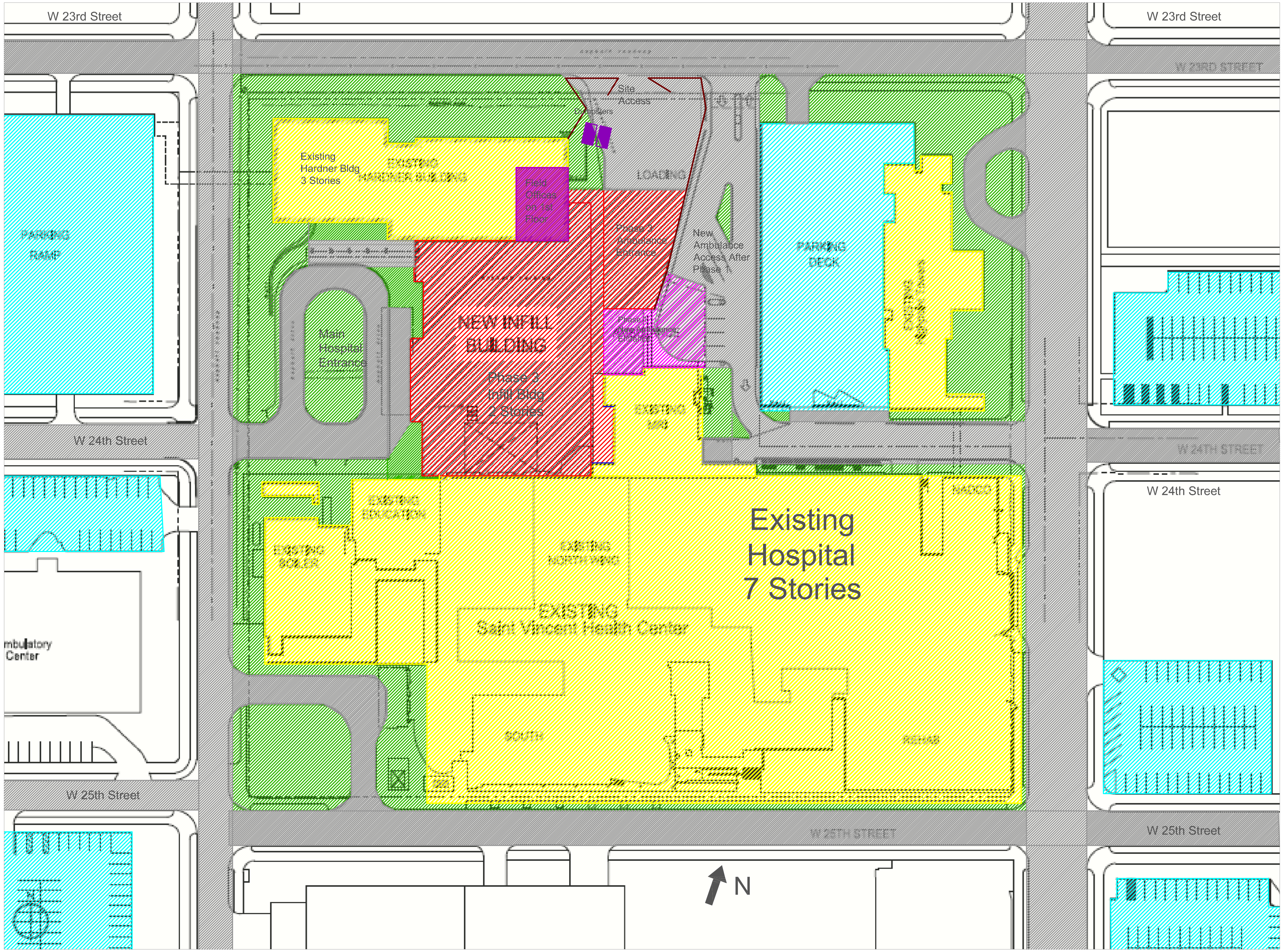
Appendix B



Legend

- 🟨 Existing Buildings
- 🟫 Site Work Area
- 🟦 Parking
- 🟩 Grass
- ⬜ Paving
- 🟪 Phase 1 Work Completed
- 🟧 Portable Toilets
- 🟪 Dumpsters
- 🟦 Storage Box/sheds
- 🟧 Material Layout
- 🟦 Phase 2 Temporary Corridor

Tyler Jaggi - CM 10/25/10	Phase 3 - Start of Structural Systems Saint Vincent Health Center	SP103



Legend

- 🟨 Existing Buildings
- ☐ Site Work Area
- 🟦 Parking
- 🟩 Grass
- ⬛ Paving
- 🟪 Phase 1 Work
- 🟥 Phase 3 Work

Tyler Jaggi - CM
10/25/10

Infill Bldg - Phase 3 Complete
Saint Vincent Health Center

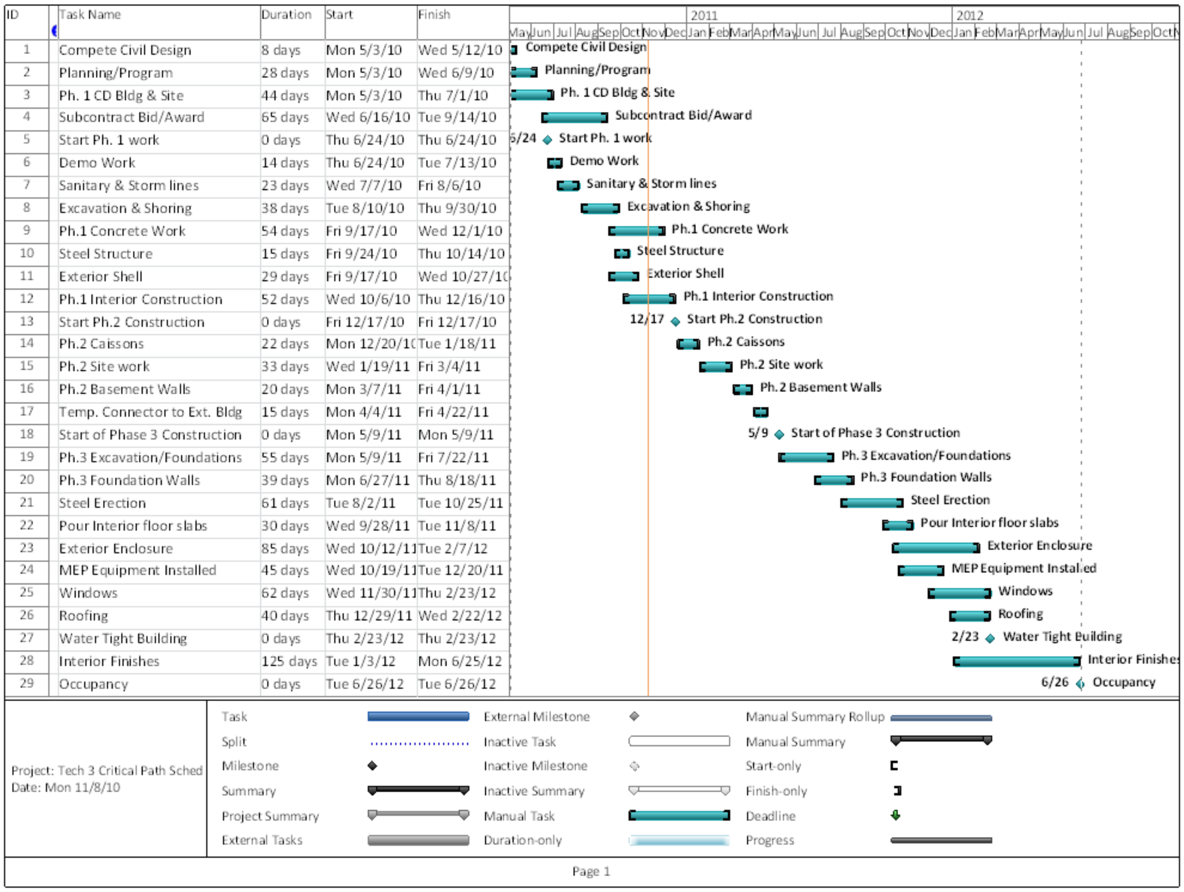
SP104

Project Schedule Summary

The project summary schedule is in **Appendix C**

The following project summary schedule is based off a more detailed schedule provided by EE Austin & Son, Inc., the construction manager on the project. The site work consists of demolishing the existing connecting corridor (Phase I) and then constructing the new emergency entrance. There is also civil work done during this time dealing with sanitary and storm lines. Following Phase I work is the construction of the temporary connecting corridor (Phase II).

After Phase II is complete, starts the substructure which includes excavation and constructing the foundations along the existing hospital buildings (phase III). The superstructure is a steel frame with composite metal decking and follows the substructure of the building. Since actual construction on this project is only starting Phase 1, this schedule isn't 100% certain. The start of Phase 3 (the main Infill Building itself) won't be started until next May. The interior design of this space is not even developed yet so the actual project finish date is unknown. I had to estimate on the schedule of the interior work and finishes for Phase 3 which I guessed would end around the start of July, 2012.



ID	Task Name	Duration	Start	Finish
1	Compete Civil Design	8 days	Mon 5/3/10	Wed 5/12/10
2	Planning/Program	28 days	Mon 5/3/10	Wed 6/9/10
3	Ph. 1 CD Bldg & Site	44 days	Mon 5/3/10	Thu 7/1/10
4	Subcontract Bid/Award	65 days	Wed 6/16/10	Tue 9/14/10
5	Start Ph. 1 work	0 days	Thu 6/24/10	Thu 6/24/10
6	Demo Work	14 days	Thu 6/24/10	Tue 7/13/10
7	Sanitary & Storm lines	23 days	Wed 7/7/10	Fri 8/6/10
8	Excavation & Shoring	38 days	Tue 8/10/10	Thu 9/30/10
9	Ph.1 Concrete Work	54 days	Fri 9/17/10	Wed 12/1/10
10	Steel Structure	15 days	Fri 9/24/10	Thu 10/14/10
11	Exterior Shell	29 days	Fri 9/17/10	Wed 10/27/1
12	Ph.1 Interior Construction	52 days	Wed 10/6/10	Thu 12/16/10
13	Start Ph.2 Construction	0 days	Fri 12/17/10	Fri 12/17/10
14	Ph.2 Caissons	22 days	Mon 12/20/1	Tue 1/18/11
15	Ph.2 Site work	33 days	Wed 1/19/11	Fri 3/4/11
16	Ph.2 Basement Walls	20 days	Mon 3/7/11	Fri 4/1/11
17	Temp. Connector to Ext. Bldg	15 days	Mon 4/4/11	Fri 4/22/11
18	Start of Phase 3 Construction	0 days	Mon 5/9/11	Mon 5/9/11
19	Ph.3 Excavation/Foundations	55 days	Mon 5/9/11	Fri 7/22/11
20	Ph.3 Foundation Walls	39 days	Mon 6/27/11	Thu 8/18/11
21	Steel Erection	61 days	Tue 8/2/11	Tue 10/25/11
22	Pour Interior floor slabs	30 days	Wed 9/28/11	Tue 11/8/11
23	Exterior Enclosure	85 days	Wed 10/12/11	Tue 2/7/12
24	MEP Equipment Installed	45 days	Wed 10/19/11	Tue 12/20/11
25	Windows	62 days	Wed 11/30/11	Thu 2/23/12
26	Roofing	40 days	Thu 12/29/11	Wed 2/22/12
27	Water Tight Building	0 days	Thu 2/23/12	Thu 2/23/12
28	Interior Finishes	125 days	Tue 1/3/12	Mon 6/25/12
29	Occupancy	0 days	Tue 6/26/12	Tue 6/26/12

Project: Tech 3 Critical Path Sched
Date: Mon 11/8/10

APPENDIX C

EE Austin Schedule

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Summary Schedule

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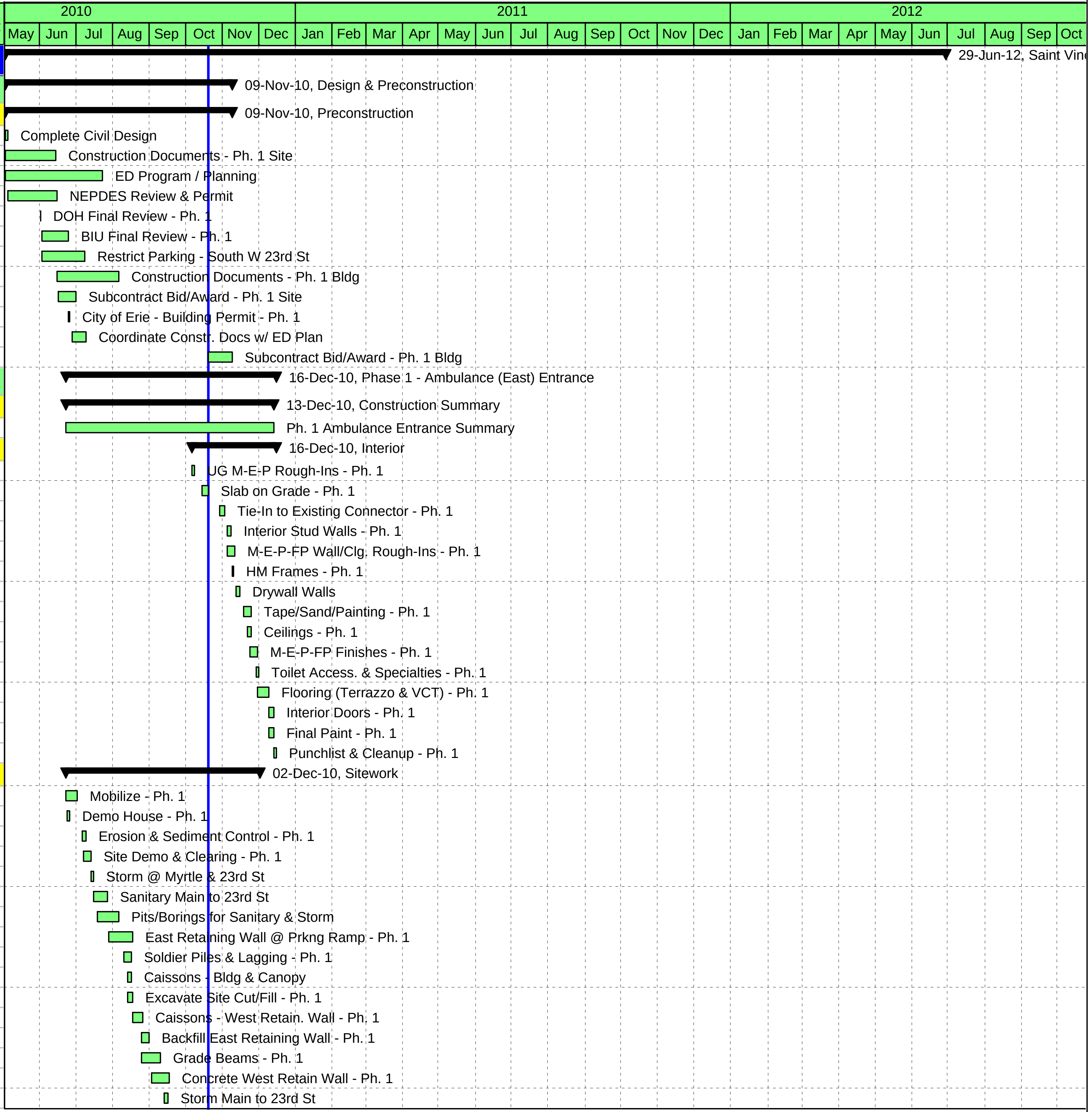
Detailed Project Schedule

Activity ID	Original Duration	Activity Name	Remaining Duration	Start	Finish	Total Float
Saint Vincent Hea	565		565	03-May-10	29-Jun-12	0
Design & Precon	137		137	03-May-10	09-Nov-10	0
Preconstruction	137		137	03-May-10	09-Nov-10	0
A1010	2	Complete Civil Design	2	03-May-10	04-May-10	
A1020	31	Construction Documents - Ph. 1 Site	31	03-May-10	14-Jun-10	
A1030	60	ED Program / Planning	60	03-May-10	23-Jul-10	
A1040	30	NEPDES Review & Permit	30	05-May-10	15-Jun-10	
A1050	1	DOH Final Review - Ph. 1	1	01-Jun-10	01-Jun-10	
A1060	17	BIU Final Review - Ph. 1	17	02-Jun-10	24-Jun-10	
A1070	27	Restrict Parking - South W 23rd St	27	02-Jun-10	08-Jul-10	
A1080	39	Construction Documents - Ph. 1 Bldg	39	15-Jun-10	06-Aug-10	
A1090	12	Subcontract Bid/Award - Ph. 1 Site	12	16-Jun-10	01-Jul-10	
A1100	1	City of Erie - Building Permit - Ph. 1	1	25-Jun-10	25-Jun-10	
A1110	10	Coordinate Constr. Docs w/ ED Plan	10	28-Jun-10	09-Jul-10	
A1120	15	Subcontract Bid/Award - Ph. 1 Bldg	15	20-Oct-10	09-Nov-10	
Phase 1 - Ambula	127		127	23-Jun-10	16-Dec-10	0
Construction Summ	124		124	23-Jun-10	13-Dec-10	0
A1130	124	Ph. 1 Ambulance Entrance Summary	124	23-Jun-10	13-Dec-10	
Interior	52		52	06-Oct-10	16-Dec-10	0
A1550	3	UG M-E-P Rough-Ins - Ph. 1	3	06-Oct-10	08-Oct-10	
A1560	4	Slab on Grade - Ph. 1	4	15-Oct-10	20-Oct-10	
A1570	3	Tie-In to Existing Connector - Ph. 1	3	29-Oct-10	02-Nov-10	
A1580	2	Interior Stud Walls - Ph. 1	2	05-Nov-10	08-Nov-10	
A1590	5	M-E-P-FP Wall/Clg. Rough-Ins - Ph. 1	5	05-Nov-10	11-Nov-10	
A1600	2	HM Frames - Ph. 1	2	09-Nov-10	10-Nov-10	
A1610	2	Drywall Walls	2	12-Nov-10	15-Nov-10	
A1620	6	Tape/Sand/Painting - Ph. 1	6	18-Nov-10	25-Nov-10	
A1630	4	Ceilings - Ph. 1	4	22-Nov-10	25-Nov-10	
A1640	5	M-E-P-FP Finishes - Ph. 1	5	24-Nov-10	30-Nov-10	
A1650	3	Toilet Access. & Specialties - Ph. 1	3	29-Nov-10	01-Dec-10	
A1660	8	Flooring (Terrazzo & VCT) - Ph. 1	8	30-Nov-10	09-Dec-10	
A1670	2	Interior Doors - Ph. 1	2	10-Dec-10	13-Dec-10	
A1680	2	Final Paint - Ph. 1	2	10-Dec-10	13-Dec-10	
A1690	3	Punchlist & Cleanup - Ph. 1	3	14-Dec-10	16-Dec-10	
Sitework	117		117	23-Jun-10	02-Dec-10	0
A1140	8	Mobilize - Ph. 1	8	23-Jun-10	02-Jul-10	
A1150	2	Demo House - Ph. 1	2	24-Jun-10	25-Jun-10	
A1160	4	Erosion & Sediment Control - Ph. 1	4	06-Jul-10	09-Jul-10	
A1170	5	Site Demo & Clearing - Ph. 1	5	07-Jul-10	13-Jul-10	
A1180	2	Storm @ Myrtle & 23rd St	2	14-Jul-10	15-Jul-10	
A1190	8	Sanitary Main to 23rd St	8	16-Jul-10	27-Jul-10	
A1200	15	Pits/Borings for Sanitary & Storm	15	19-Jul-10	06-Aug-10	
A1210	15	East Retaining Wall @ Prkng Ramp - Ph. 1	15	28-Jul-10	17-Aug-10	
A1220	5	Soldier Piles & Lagging - Ph. 1	5	10-Aug-10	16-Aug-10	
A1230	2	Caissons - Bldg & Canopy	2	13-Aug-10	16-Aug-10	
A1240	3	Excavate Site Cut/Fill - Ph. 1	3	13-Aug-10	17-Aug-10	
A1250	7	Caissons - West Retain. Wall - Ph. 1	7	18-Aug-10	26-Aug-10	
A1260	5	Backfill East Retaining Wall - Ph. 1	5	25-Aug-10	31-Aug-10	
A1270	12	Grade Beams - Ph. 1	12	25-Aug-10	09-Sep-10	
A1280	12	Concrete West Retain Wall - Ph. 1	12	02-Sep-10	17-Sep-10	
A1290	4	Storm Main to 23rd St	4	13-Sep-10	16-Sep-10	

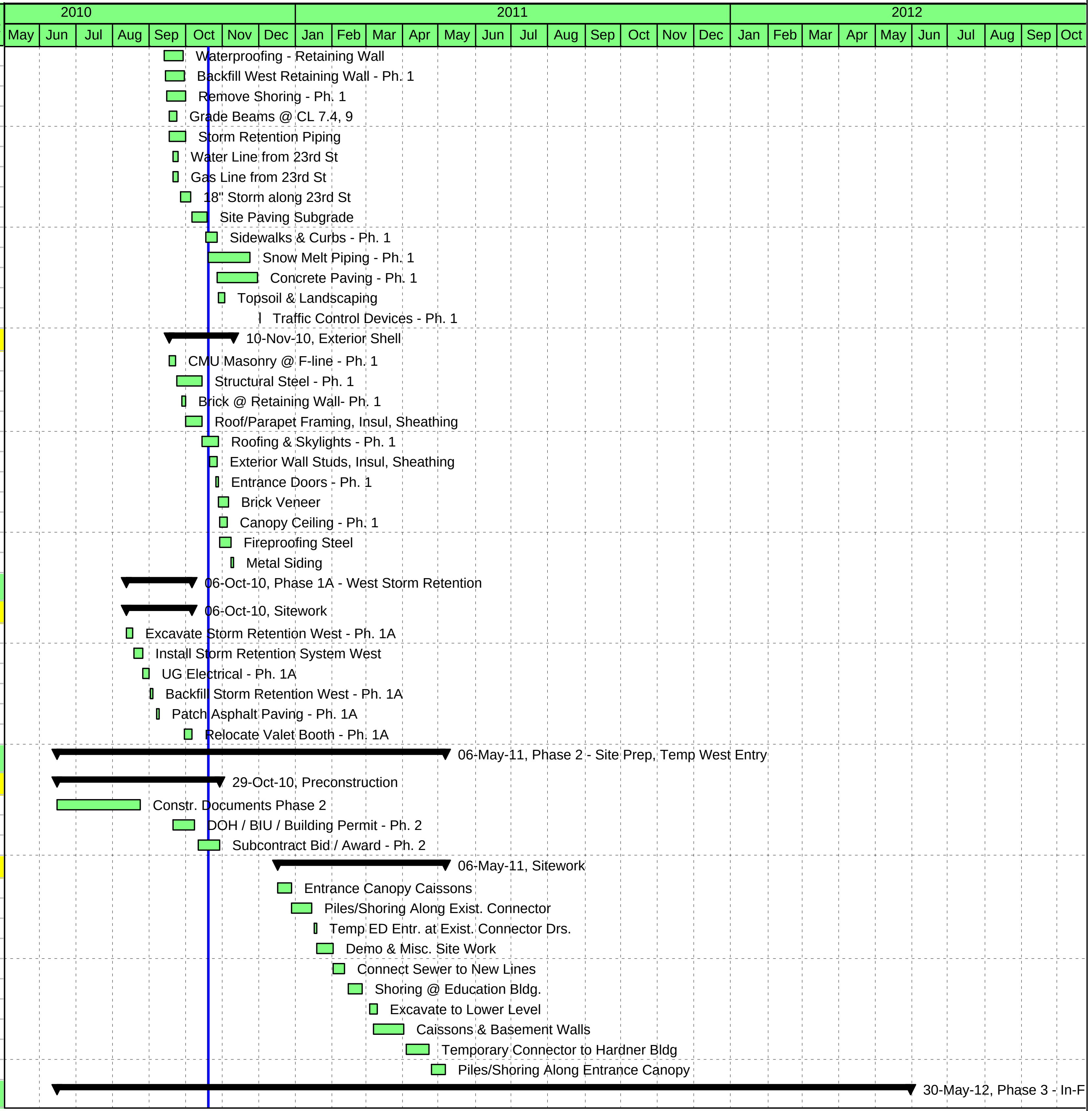


🟦 Actual Work 🟥 Critical Remaining Work ▬ Summary

🟩 Remaining Work ◆ ◆ Milestone

TASK filter: All Activities

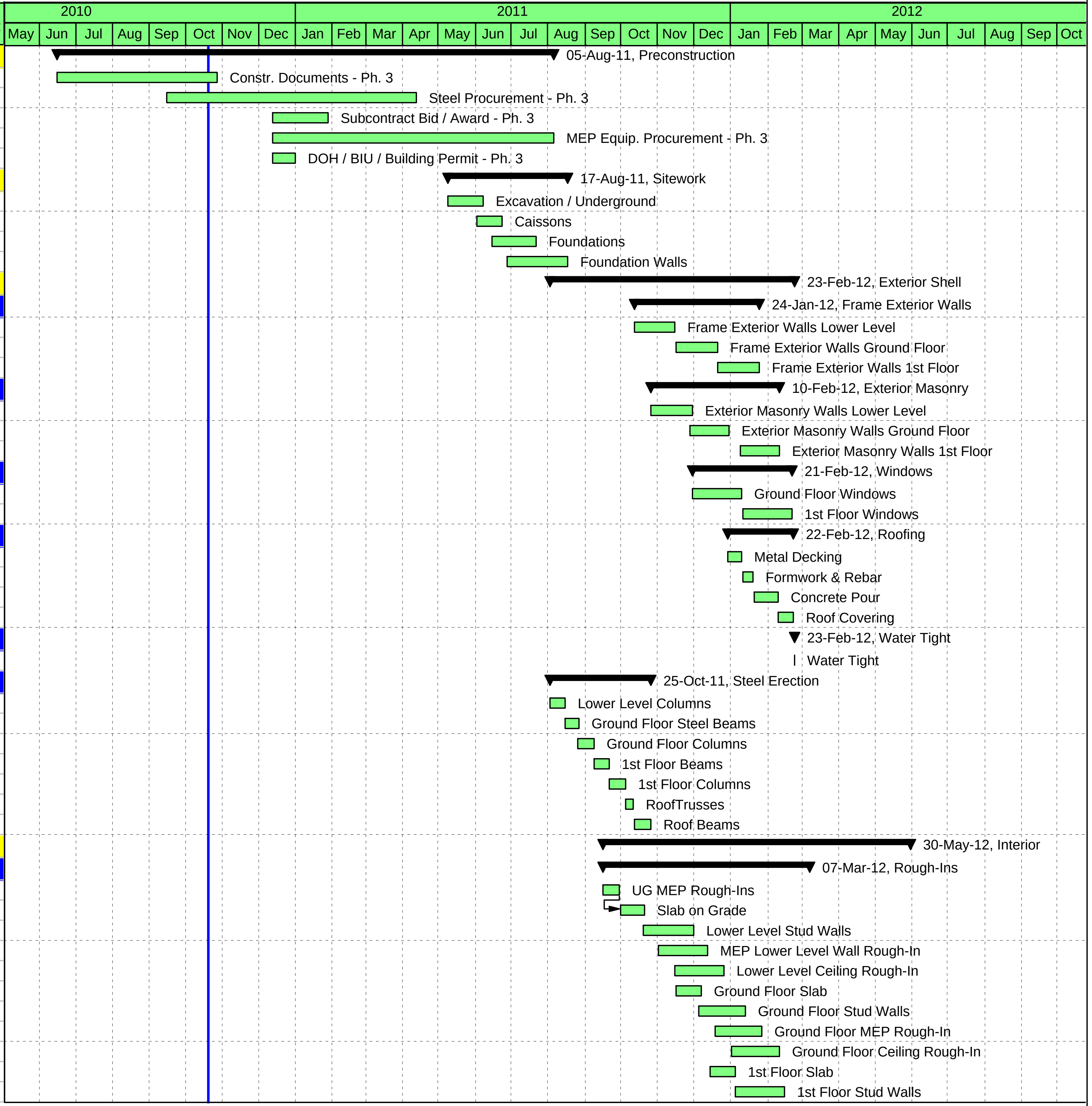
Activity ID	Original Duration	Activity Name	emaining Duration	Start	Finish	Total Float
A1300	12	Waterproofing - Retaining Wall	12	13-Sep-10	28-Sep-10	
A1310	12	Backfill West Retaining Wall - Ph. 1	12	14-Sep-10	29-Sep-10	
A1320	12	Remove Shoring - Ph. 1	12	15-Sep-10	30-Sep-10	
A1330	5	Grade Beams @ CL 7.4, 9	5	17-Sep-10	23-Sep-10	
A1340	10	Storm Retention Piping	10	17-Sep-10	30-Sep-10	
A1350	5	Water Line from 23rd St	5	20-Sep-10	24-Sep-10	
A1360	5	Gas Line from 23rd St	5	20-Sep-10	24-Sep-10	
A1370	7	18" Storm along 23rd St	7	27-Sep-10	05-Oct-10	
A1380	10	Site Paving Subgrade	10	06-Oct-10	19-Oct-10	
A1390	8	Sidewalks & Curbs - Ph. 1	8	18-Oct-10	27-Oct-10	
A1400	25	Snow Melt Piping - Ph. 1	25	20-Oct-10	23-Nov-10	
A1410	25	Concrete Paving - Ph. 1	25	27-Oct-10	30-Nov-10	
A1420	4	Topsoil & Landscaping	4	28-Oct-10	02-Nov-10	
A1430	1	Traffic Control Devices - Ph. 1	1	02-Dec-10	02-Dec-10	
Exterior Shell	39		39	17-Sep-10	10-Nov-10	0
A1440	4	CMU Masonry @ F-line - Ph. 1	4	17-Sep-10	22-Sep-10	
A1450	15	Structural Steel - Ph. 1	15	24-Sep-10	14-Oct-10	
A1460	4	Brick @ Retaining Wall- Ph. 1	4	28-Sep-10	01-Oct-10	
A1470	10	Roof/Parapet Framing, Insul, Sheathing	10	01-Oct-10	14-Oct-10	
A1480	10	Roofing & Skylights - Ph. 1	10	15-Oct-10	28-Oct-10	
A1490	5	Exterior Wall Studs, Insul, Sheathing	5	21-Oct-10	27-Oct-10	
A1500	3	Entrance Doors - Ph. 1	3	26-Oct-10	28-Oct-10	
A1510	7	Brick Veneer	7	28-Oct-10	05-Nov-10	
A1520	5	Canopy Ceiling - Ph. 1	5	29-Oct-10	04-Nov-10	
A1530	7	Fireproofing Steel	7	29-Oct-10	08-Nov-10	
A1540	3	Metal Siding	3	08-Nov-10	10-Nov-10	
Phase 1A - West	40		40	12-Aug-10	06-Oct-10	0
Sitework	40		40	12-Aug-10	06-Oct-10	0
A1700	4	Excavate Storm Retention West - Ph. 1A	4	12-Aug-10	17-Aug-10	
A1710	6	Install Storm Retention System West	6	19-Aug-10	26-Aug-10	
A1720	4	UG Electrical - Ph. 1A	4	26-Aug-10	31-Aug-10	
A1730	3	Backfill Storm Retention West - Ph. 1A	3	01-Sep-10	03-Sep-10	
A1740	2	Patch Asphalt Paving - Ph. 1A	2	07-Sep-10	08-Sep-10	
A1750	5	Relocate Valet Booth - Ph. 1A	5	30-Sep-10	06-Oct-10	
Phase 2 - Site Pre	234		234	15-Jun-10	06-May-11	0
Preconstruction	99		99	15-Jun-10	29-Oct-10	0
A1760	50	Constr. Documents Phase 2	50	15-Jun-10	23-Aug-10	
A1770	15	DOH / BIU / Building Permit - Ph. 2	15	20-Sep-10	08-Oct-10	
A1780	15	Subcontract Bid / Award - Ph. 2	15	11-Oct-10	29-Oct-10	
Sitework	101		101	17-Dec-10	06-May-11	0
A1800	8	Entrance Canopy Caissons	8	17-Dec-10	28-Dec-10	
A1810	13	Piles/Shoring Along Exist. Connector	13	29-Dec-10	14-Jan-11	
A1820	2	Temp ED Entr. at Exist. Connector Drs.	2	17-Jan-11	18-Jan-11	
A1830	10	Demo & Misc. Site Work	10	19-Jan-11	01-Feb-11	
A1840	8	Connect Sewer to New Lines	8	02-Feb-11	11-Feb-11	
A1850	10	Shoring @ Education Bldg.	10	14-Feb-11	25-Feb-11	
A1860	5	Excavate to Lower Level	5	04-Mar-11	10-Mar-11	
A1870	20	Caissons & Basement Walls	20	07-Mar-11	01-Apr-11	
A1880	15	Temporary Connector to Hardner Bldg	15	04-Apr-11	22-Apr-11	
A1890	10	Piles/Shoring Along Entrance Canopy	10	25-Apr-11	06-May-11	
Phase 3 - In-Fill E	512		512	15-Jun-10	30-May-12	0



🟦 Actual Work
🟥 Critical Remaining Work
▼ Summary
🟩 Remaining Work ◆
◆ Milestone

TASK filter: All Activities

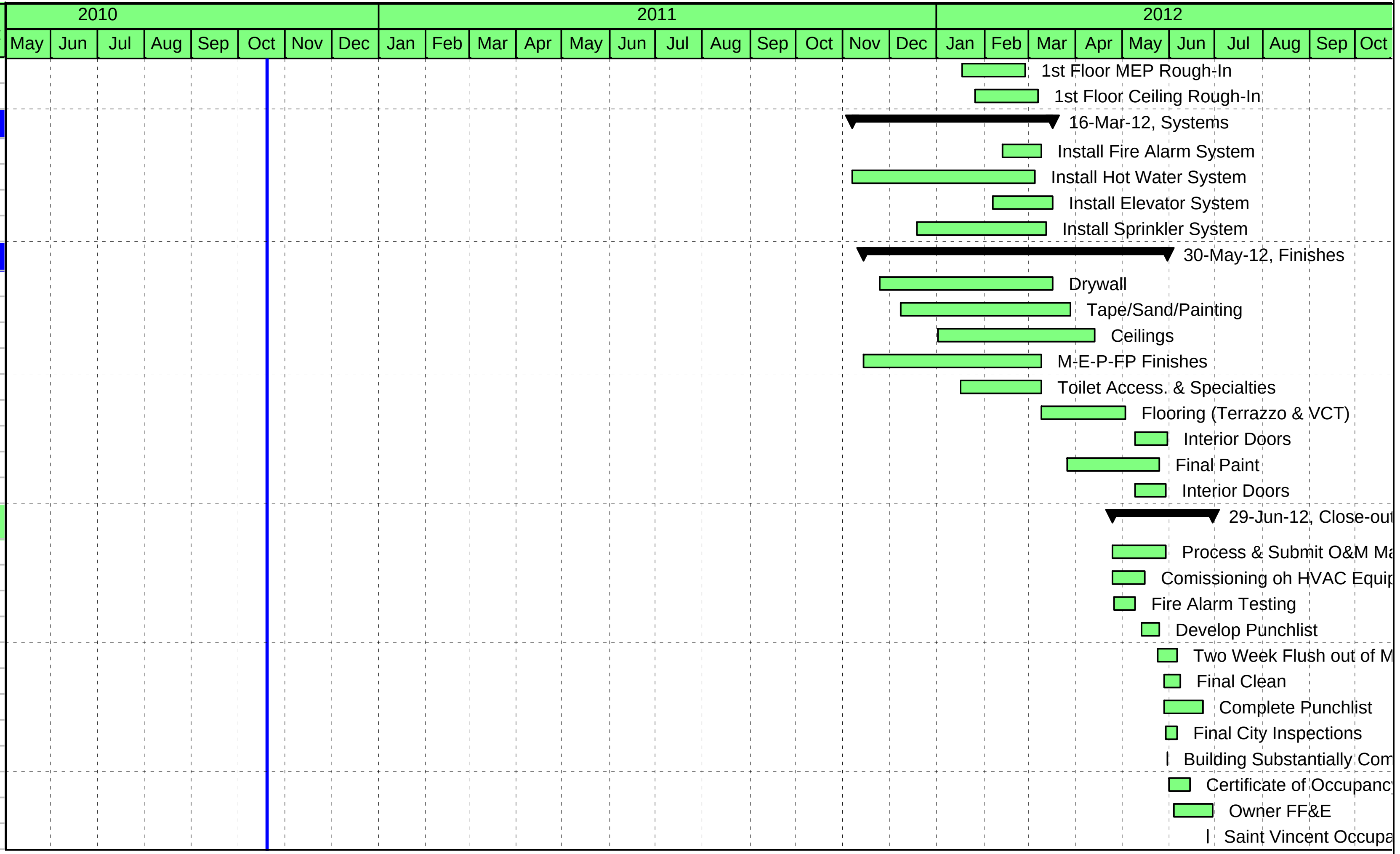
Activity ID	Original Duration	Activity Name	Remaining Duration	Start	Finish	Total Float
Preconstruction	299		299	15-Jun-10	05-Aug-11	0
A1900	97	Constr. Documents - Ph. 3	97	15-Jun-10	27-Oct-10	
A1910	150	Steel Procurement - Ph. 3	150	15-Sep-10	12-Apr-11	
A1930	35	Subcontract Bid / Award - Ph. 3	35	13-Dec-10	28-Jan-11	
A1940	170	MEP Equip. Procurement - Ph. 3	170	13-Dec-10	05-Aug-11	
A1920	15	DOH / BIU / Building Permit - Ph. 3	15	13-Dec-10	31-Dec-10	
Sitework	73		73	09-May-11	17-Aug-11	0
A1950	22	Excavation / Underground	22	09-May-11	07-Jun-11	
A1960	16	Caissons	16	02-Jun-11	23-Jun-11	
A1970	27	Foundations	27	15-Jun-11	21-Jul-11	
A1980	38	Foundation Walls	38	27-Jun-11	17-Aug-11	
Exterior Shell	147		147	02-Aug-11	23-Feb-12	0
Frame Exterior Wa	75		75	12-Oct-11	24-Jan-12	0
A2060	25	Frame Exterior Walls Lower Level	25	12-Oct-11	15-Nov-11	
A2070	25	Frame Exterior Walls Ground Floor	25	16-Nov-11	20-Dec-11	
A2080	25	Frame Exterior Walls 1st Floor	25	21-Dec-11	24-Jan-12	
Exterior Masonry	78		78	26-Oct-11	10-Feb-12	0
A2090	25	Exterior Masonry Walls Lower Level	25	26-Oct-11	29-Nov-11	
A2100	25	Exterior Masonry Walls Ground Floor	25	28-Nov-11	30-Dec-11	
A2110	25	Exterior Masonry Walls 1st Floor	25	09-Jan-12	10-Feb-12	
Windows	60		60	30-Nov-11	21-Feb-12	0
A2120	30	Ground Floor Windows	30	30-Nov-11	10-Jan-12	
A2130	30	1st Floor Windows	30	11-Jan-12	21-Feb-12	
Roofing	40		40	29-Dec-11	22-Feb-12	0
A2140	9	Metal Decking	9	29-Dec-11	10-Jan-12	
A2150	7	Formwork & Rebar	7	11-Jan-12	19-Jan-12	
A2160	15	Concrete Pour	15	20-Jan-12	09-Feb-12	
A2170	9	Roof Covering	9	10-Feb-12	22-Feb-12	
Water Tight	0		0	23-Feb-12	23-Feb-12	0
A2180	0	Water Tight	0	23-Feb-12	23-Feb-12	
Steel Erection	61		61	02-Aug-11	25-Oct-11	0
A1990	10	Lower Level Columns	10	02-Aug-11	15-Aug-11	
A2000	10	Ground Floor Steel Beams	10	15-Aug-11	26-Aug-11	
A2010	10	Ground Floor Columns	10	26-Aug-11	08-Sep-11	
A2020	10	1st Floor Beams	10	08-Sep-11	21-Sep-11	
A2030	10	1st Floor Columns	10	21-Sep-11	04-Oct-11	
A2040	5	RoofTrusses	5	05-Oct-11	11-Oct-11	
A2050	10	Roof Beams	10	12-Oct-11	25-Oct-11	
Interior	184		184	16-Sep-11	30-May-12	0
Rough-Ins	124		124	16-Sep-11	07-Mar-12	0
A2190	10	UG MEP Rough-Ins	10	16-Sep-11	29-Sep-11	
A2200	15	Slab on Grade	15	30-Sep-11	20-Oct-11	
A2210	30	Lower Level Stud Walls	30	20-Oct-11	30-Nov-11	
A2220	30	MEP Lower Level Wall Rough-In	30	01-Nov-11	12-Dec-11	
A2230	30	Lower Level Ceiling Rough-In	30	15-Nov-11	26-Dec-11	
A2240	15	Ground Floor Slab	15	16-Nov-11	07-Dec-11	
A2250	30	Ground Floor Stud Walls	30	05-Dec-11	13-Jan-12	
A2260	30	Ground Floor MEP Rough-In	30	19-Dec-11	27-Jan-12	
A2270	30	Ground Floor Ceiling Rough-In	30	02-Jan-12	10-Feb-12	
A2280	15	1st Floor Slab	15	14-Dec-11	04-Jan-12	
A2290	30	1st Floor Stud Walls	30	05-Jan-12	15-Feb-12	



🟦 Actual Work 🟥 Critical Remaining Work Summary
🟩 Remaining Work ◆ Milestone

TASK filter: All Activities

Activity ID	Original Duration	Activity Name	Remaining Duration	Start	Finish	Total Float
A2300	30	1st Floor MEP Rough-In	30	17-Jan-12	27-Feb-12	
A2310	30	1st Floor Ceiling Rough-In	30	26-Jan-12	07-Mar-12	
Systems	95		95	07-Nov-11	16-Mar-12	0
A2320	20	Install Fire Alarm System	20	13-Feb-12	09-Mar-12	
A2330	86	Install Hot Water System	86	07-Nov-11	05-Mar-12	
A2340	30	Install Elevator System	30	06-Feb-12	16-Mar-12	
A2350	61	Install Sprinkler System	61	19-Dec-11	12-Mar-12	
Finishes	143		143	14-Nov-11	30-May-12	0
A2360	81	Drywall	81	24-Nov-11	16-Mar-12	
A2370	80	Tape/Sand/Painting	80	08-Dec-11	28-Mar-12	
A2380	75	Ceilings	75	02-Jan-12	13-Apr-12	
A2390	85	M-E-P-FP Finishes	85	14-Nov-11	09-Mar-12	
A2400	40	Toilet Access. & Specialties	40	16-Jan-12	09-Mar-12	
A2410	40	Flooring (Terrazzo & VCT)	40	09-Mar-12	03-May-12	
A2420	15	Interior Doors	15	09-May-12	30-May-12	
A2430	45	Final Paint	45	26-Mar-12	25-May-12	
A2440	15	Interior Doors	15	09-May-12	29-May-12	
Close-out	48		48	25-Apr-12	29-Jun-12	0
A2450	25	Process & Submit O&M Manuals	25	25-Apr-12	29-May-12	
A2460	15	Comissioning oh HVAC Equipment	15	25-Apr-12	15-May-12	
A2470	10	Fire Alarm Testing	10	26-Apr-12	09-May-12	
A2480	10	Develop Punchlist	10	14-May-12	25-May-12	
A2490	10	Two Week Flush out of Mechanical system	10	24-May-12	06-Jun-12	
A2500	10	Final Clean	10	28-May-12	08-Jun-12	
A2510	20	Complete Punchlist	20	28-May-12	22-Jun-12	
A2520	5	Final City Inspections	5	30-May-12	05-Jun-12	
A2530	0	Building Substantially Compete	0	31-May-12	31-May-12	
A2540	10	Certificate of Occupancy	10	01-Jun-12	14-Jun-12	
A2550	20	Owner FF&E	20	04-Jun-12	29-Jun-12	
A2560	0	Saint Vincent Occupancy	0	26-Jun-12	26-Jun-12	



🟦 Actual Work 🟥 Critical Remaining Work ▼ Summary
🟩 Remaining Work ◆ ◆ Milestone

TASK filter: All Activities

Building Systems Summary

MEP System:

Central Plant (lower Level):

The new boiler plant will serve the existing hospital and for future expansion. A new chiller plant will serve this addition and be set up for future expansion. The Central Plant will leave room for even more possible future expansions. The control system will be an automated system. All systems described will be designed with the intent of reaching the LEED “Silver” Certification.

Steam systems:

The Steam System will have five (5) 350hp boilers including piping and accessories. It will include all valves for future additions to the steam system at this time. There will be space left for two additional 350 hp boilers, including valves for the future addition to the steam system at this time.

The system will have a new flue stack routed up along the existing North building. System shall include steam header, feed water, surge tank, chemical treatment, blow down separator, water softeners, flue gas economizer, ventilation, temperature controls, ect. All systems shall be sized for the addition of a future boiler.

There will be new piping through the new addition and connected to the existing mains located in the ceiling space of the lower level of the existing building.

Heating water will be supplied by two steam-to-water heat exchangers; one standby. The heating/reheat system will be served by two variable speed, based mounted, pumps; one pump will run while the other remains standby. Each floor will have an independent, direct return piping arrangement.

Chilled water/Condenser water:

Build a new chiller plant to serve this addition and future additions. Provide a new two cell cooling tower on the new ground floor roof. Provide sound attenuating louvered screen wall.

New cooling tower pumps & chilled water pump package shall include headers, valves, drives, controls, and provisions for future additions to the system. The pump packages are located in the lower level chiller room.

Provide (2) 750 ton centrifugal chillers/pumps to the chiller plant. (Adequate space will be left in the Plant for an additional 750 ton chiller and an additional cell to the cooling tower on the roof to serve the future. Size piping for future additional chilled water load.)

Ventilation:

Provide a new dedicated ventilation system in Chiller and Boiler rooms. The Chiller Room will be built to meet ASHRAE Guideline 15. The Boiler Room shall include combustion air fans and a general exhaust system. System will provide intake and relief louvers associated with the chiller, boiler ventilation systems and the central storage HVAC unit. There will be ventilation and exhaust ductwork and sound attenuating louvers to serve new generators. They will route the generator exhaust up along the new East stair tower.

Building Automation System (BAS):

The existing Control System will be upgraded and include a new web based system. Upgrade will include replacement of existing controllers, cabling, new Application and Data Server, graphics, and owner training. The new boiler system, chiller/tower system, generator/ fuel system, HVAC units, exhaust fans, unit heaters, cabinet unit heaters, and all other new mechanical and electrical systems shall be connected to the BAS system. A new temperature control air compressor shall be provided, sized to serve new and existing systems.

Plumbing:

The Plumbing system will rework the existing hospital storm and sanitary sewer systems that currently discharge to the city sewers located on 24th Street. It will route new gravity sewers to the north and connect to new sanitary and storm stubs.

A new storm sump located in the lower level will serve an underfloor drain tile system and footing drains. A new sanitary ejector will serve the lower level floor drains and misc. plumbing fixtures. The new additions ground, first, and future floors storm and sanitary sewers will flow by gravity to the west side of the site.

A new domestic water, fire, and gas service will enter the new addition on the west side. The backflow preventers and meters shall conform to local requirements. The new system will extend and connect the new water and gas service to the existing main within the existing hospital. Also, it will extend a new water service to the MOB building.

The steam to water domestic hot water heaters will be added to the Central Plant to serve the new addition and back feed to serve the existing hospital. These (3) units are sized to serve the future additions and will be connected to the existing piping system.

Medical gases:

All medical gases and vacuum units will be upgraded to allow for increased capacity. This will include a new medical vacuum, anesthesia evacuation and medical air pumps that will be added to the existing system. Nitrous oxide & nitrogen tank systems will be further evaluated. The existing bulk oxygen tank will remain.

Fuel oil:

New fuel oil tanks/pumps/filter/piping serving the new generators and boiler will standby fuel needs. This equipment will be placed in new addition and allow for expansion of central plant.

Fire Protection:

Close coordination will be required between the City, the Owners Insurance Underwriter and the Design team. A new fire service will serve the existing hospital, this addition, and the Medical office building.

A new electric fire pump will serve the new addition and existing facility. There will be standpipes with floor control valve and drain in each stair tower that shall serve each floor. They will be extending a new fire line to serve the existing Hardener Building. They will also extend a new fire line to connect into the existing fire main located in the existing hospital.

The system will provide fire dept. connections, fire pump test header, and indicating valve. Relocate existing fire dept connections impacted by this project. The lower level will be fully sprinkled to Ordinary Hazard Group 2.

Electrical System Description:

The existing hospital is served by two 36KV primary services. Each service originates from separate substations. There are two 5MVA transformers that serve the hospital. Both transformers are energized and share the load of the hospital via a 4160V main-tie-main switchgear lineup in the lower level of the existing facility. The existing maximum load served by the two transformers is 4.4MVA.

Normal Power service for the addition will be an extension of the existing main-tie-main 4160V switchgear located in the lower level of the existing facility. A single 4160V feeder will be serve a medium voltage load interrupter switchgear lineup located in the lower level of the addition. The four feeder switches in this switchgear will serve the two new 1500KVA double ended unit substations. Space will be left in the lower level of the addition for a future new 4160V vacuum circuit breaker line up. This future 4160V gear shall be installed when the 5MVA transformers are replaced.

Emergency Power for the Hospital:

The new addition shall include two new 1000KW generators and new paralleling switchgear. The parallel switchgear was sized to include the addition of one future 1000KW generator.

Building Envelope & Façade:

The Specifics on the building envelope are still being developed
Most will be 8” CMU with rigid insulation & a 2”stone veneer. Some places will be aluminum siding

panels, and some brick veneer to match the adjacent Harder Building. Masonry is not load bearing; they are for the veneer.

Lighting System:

Design is only up to building enclosure. Therefore this system is not designed yet.

Roofing system:

The Roofing system of the Saint Vincent Medical Center Infill Building is composed of W18x35 & W10x12 beams, W24x55 & W18x40 Girders. The roof structure will be steel composite decking with a concrete roof. This roof is designed to be the possible 3rd floor in the future, with columns of the existing structure sized for the expansion of 3 additional floors in the future.

Structural system:

The structural system for the Saint Vincent Health Center Infill Building consists of a steel frame structure supported by deep foundations. The current roof/future third floor along with the ground and first floors are framed with a 4" concrete slab on a 2" composite steel metal deck spanning between composite wide flange steel framing. Steel beams and girders carry gravity loads to steel columns supported on concrete caissons. Special design features include transfer girders located on the roof / future 3rd floor to create large open spaces at the new operating rooms, steel bents cantilevering 40' at the front entry, and permanent drilled solider pile and lagging walls to support deep excavations adjacent to existing buildings.

Sustainability Features:

This project is a LEED certified project with the hope of attaining a Silver certification.
The structure of the building is designed with the possibility of adding 3 additional floors in the future. New columns would line up with the existing column below them. These columns are sized larger than needed for the 3 story structure but are designed that way for the possibility of a 3 story addition.

There will also be solar shades to block some of the sun's rays from overheating the building.

In the basement of this new building, they are putting in a new state of the art Central MEP Plant that will replace the entire MEP services for the entire complex of buildings. This plant will be more efficient than the complex's existing one.

Demolition:

There will be demolition during Phase II. Phase II will be demolishing the existing connecting corridor between the two existing buildings. This building is masonry brick with no harmful materials.

Excavation Support:

The type of excavation support system being used is soldier piles & lagging. Some of these piles will be permanent near the existing building. Dewatering systems will be used if needed.

Project Cost Evaluation

PCS Estimated Cost:

Back in February, PCS (Project and Construction Services, Inc.) did an estimate based on the early preliminary drawing, narratives, emails and verbal instructions. There have been changes to the designs to vary the cost estimate but this was Saint Vincent's rough estimate.

PCS Schematic Design Estimate

Division	Building Component		Cost per SF	**Shell Only 104,660 SF**	Cost per SF	**Total, w/Fit-out 104,660 SF**
1	General Conditions			**See Below**		**See Below**
2	Demo & Site Work		$6.50	**$680,070**	$6.50	**$680,070**
3	Excavation and Foundations		$23.02	**$2,409,639**	$23.02	**$2,409,639**
4	Structural Systems		$22.45	**$2,349,803**	$22.45	**$2,349,803**
5	Exterior Wall, Door & Glass systems		$15.64	**$1,637,120**	$15.64	**$1,637,120**
6	Thermal & Moisture Protection		$9.83	**$1,029,204**	$9.83	**$1,029,204**
7	Rough Carpendry & Misc. Metals		$2.10	**$219,851**	$4.46	**$466,289**
8	Interior Wall, Door & Glass systems		$2.64	**$276,400**	$16.37	**$1,713,150**
9	Floor, Wall & Ceiling Finishes		$0.55	**$57,100**	$12.36	**$1,293,214**
10 - 12	Fixed Equipment & Specialties		$0.00			**$580,510**
14	Conveying Systems (Future)			**Not Included**		**Not Included**
15	Mechanical Systems					
	- Plumbing		$4.59	**$480,488**	$17.49	**$1,831,005**
	- Fire Protection		$0.84	**$88,124**	$4.82	**$504,881**
	- H.V.A.C.		$9.58	**$1,002,600**	$67.45	**$7,059,567**
16	Electrical Systems		$12.17	**$1,273,299**	$51.63	**$5,403,384**
		%	Cost per SF	**Shell Only**	Cost per SF	**Total, w/Fit-out**
Subtotal All Trades Work			$109.91	**$11,503,698**	$257.58	**$26,957,836**
General Conditions for Divisions 2 thru 16		9.00%	$9.89	**$1,035,333**	$23.18	**$2,426,205**
Contractor Overhead and Profit for Div 2 thru 16		5.00%	$5.99	**$626,952**	$14.04	**$1,469,202**
Escalate to Midpoint of Construction; Start 3/1/11		6.21%	$7.82	**$818,220**	$18.32	**$1,917,421**
Contingency: Design, Estimating, Bidding		8.00%	$10.69	**$1,118,736**	$25.05	**$2,621,653**
LEED Silver Premium		3.00%	$4.33	**$453,088**	$10.14	**$1,061,770**

Total Probable Construction Cost:	Cost per SF	$148.63	**$15,556,026**	$348.31	**$36,454,087**

Actual Building Cost:

Phase II and III of the Saint Vincent Health Center project have yet to be bid out because the design is not fully developed. The main building, the Infill Building, is only designed up to the enclosure. None of the interior is designed. No rooms, hallways, lighting, etc. has been design, which means it hasn't been bided on yet. The project team believes the total project cost will be approximately $45 million.

Producing a major building system cost report is hard to do without having a detailed and accurate estimate on this project. All system estimates are in the tables and are giving in total cost and cost per square foot.

D4 Project Estimate: Appendix D

Appendix D has the detailed D4 cost Evaluation. The D4 adjusted estimate wasn't close to the estimated project cost before adjusting the square foot cost due to the time difference. This could be because Saint Vincent's new addition will be a large part of new operating rooms which cost tremendously more than the typical patient room.

D4 Cost Estimation Building Comparison Info		
Project Name	**Saint Vincent Health Center**	**Emergency & Med-Surgical Pavilion**
Project Cost	Estimated $45 Mil	$30,555,440.00
Building Size (SF)	104,660	111,871
Site Size (SF)	Approx. 300,000	621,166
Building Use	Medical	Medical
Bid Date	1/1/2011	4/23/2003
Number of Floors	3 (1 below ground)	2
Projected Location	Erie, PA	NJ - Other

RS Means 2010 Cost Estimate: Appendix D

To develop an RS Means building cost estimate, RS Means – Cost Works online service was used. RS Means does not have an accurate building type to account for a Medical hospital with the same building systems as the Saint Vincent Health Center. SVHC has a whole floor of high technology operation rooms along with state of the art patient rooms. SVHC structural system is also sized for the future upward expansion, so the cost is higher than the typical two story hospital. No RS Means building type encompasses all of those systems so it was not expected to produce an accurate building cost estimate for this type of project. This RS Means estimate is nearly $20 million less than the approximate estimate of $45 million.

APPENDIX D

D4 Estimate

&

RS Means Estimate

Appendix D

D4 Cost Estimate

					Saint Vincent Health Center		
Emergency & Med-Surgical Pavilion					Estimated Total Cost By:		
Code	**Division Name**	**%**	**Sq. Cost**	**Adj. Cost/Sf**	**%**	**Cost/SF**	**Adj Cost/SF**
00	Bidding Requirements	9.79	26.75	40.125	$4,405,500	$2,799,655	$4,199,483
	Bonds & Certificates	1.03	2.81	4.209	$462,311	$293,680	$440,520
	General Conditions	8.76	23.94	35.909	$3,944,113	$2,505,466	$3,758,199
01	General Requirements	8.45	23.08	34.620	$3,802,500	$2,415,553	$3,623,329
	Alternates/Alternatives	2.45	6.70	10.056	$1,104,550	$701,656	$1,052,485
	Constr. Facilities & Temp. Controls	1.74	4.74	7.114	$781,432	$496,398	$744,598
	Contract Closeout (Trade Cleanup)	1.16	3.16	4.734	$520,022	$330,340	$495,510
	Summary Of Work (Insurance)	3.10	8.48	12.713	$1,396,380	$887,040	$1,330,559
03	Concrete	4.36	11.91	17.865	$1,962,000	$1,246,501	$1,869,751
	Cast-In-Place	4.36	11.91	17.860	$1,961,680	$1,246,142	$1,869,213
04	Masonry	1.32	3.61	5.415	$594,000	$377,823	$566,734
	Unit	1.32	3.61	5.416	$594,866	$377,884	$566,826
05	Metals	5.39	14.73	22.095	$2,425,500	$1,541,642	$2,312,463
	Fabrications	0.56	1.54	2.313	$254,046	$161,381	$242,071
	Structural Framing	4.83	13.19	19.784	$2,173,017	$1,380,392	$2,070,588
06	Wood & Plastics	4.21	11.50	17.250	$1,894,500	$1,203,590	$1,805,385
	Architectural Woodwork	3.52	9.61	14.414	$1,583,188	$1,005,707	$1,508,561
	Rough Carpentry	0.69	1.90	2.843	$312,219	$198,335	$297,502
07	Thermal & Moisture Protection	8.19	22.36	33.540	$3,685,500	$2,340,198	$3,510,296
	EIFS	0.22	0.60	0.898	$98,673	$62,681	$94,022
	Exterior Wall Assemblies	5.18	14.15	21.225	$2,331,264	$1,480,917	$2,221,375
	Fireproofing	0.54	1.46	2.193	$240,902	$153,031	$229,547
	Firestopping	0.10	0.28	0.417	$45,839	$29,119	$43,678
	Joint Sealers	0.11	0.31	0.459	$50,441	$32,042	$48,063
	Membrane Roofing	1.83	5.00	7.504	$824,215	$523,576	$785,364
	Waterproofing & Dampproofing	0.20	0.56	0.838	$92,046	$58,471	$87,707
08	Doors & Windows	4.28	11.68	17.520	$1,926,000	$1,222,429	$1,833,643
	Doors/Frames/Hardware	1.34	3.65	5.481	$601,980	$382,403	$573,604
	Glazing	2.89	7.88	11.827	$1,299,098	$825,241	$1,237,862
	Special Doors	0.05	0.14	0.208	$22,827	$14,501	$21,751
09	Finishes	12.52	34.20	51.300	$5,634,000	$3,579,372	$5,369,058
	Metal Stud/Gypsum Board	8.57	23.42	35.131	$3,858,669	$2,451,189	$3,676,783
	Painting/Wall Coverings	0.91	2.49	3.741	$410,892	$261,016	$391,524
	Resilient Flooring/Carpet	1.76	4.80	7.200	$790,858	$502,386	$753,579
	Stone Flooring/Tile	1.28	3.49	5.229	$574,329	$364,838	$547,257
10	Specialties	0.41	1.11	1.665	$184,500	$116,173	$174,259
	Comp. & Cubicles/Curtain & IV Track	0.34	0.92	1.374	$150,881	$95,846	$143,769
	Fire Protection	0.02	0.04	0.064	$7,069	$4,491	$6,736
	Partitions	0.05	0.13	0.201	$22,091	$14,033	$21,050
	Wall & Corner Guards	0.01	0.02	0.025	$2,702	$1,717	$2,575
14	Conveying Systems	1.23	3.36	5.040	$553,500	$351,658	$527,486
	Elevators	1.23	3.36	5.042	$553,748	$351,764	$527,646
15	Mechanical	27.37	74.76	112.140	$12,316,500	$7,824,382	$11,736,572
	Basic Materials & Methods	3.93	10.73	16.090	$1,767,279	$1,122,650	$1,683,975
	Fire Protection	1.44	3.93	5.892	$647,156	$411,100	$616,651
	Plumbing & HVAC	22.01	60.11	90.163	$9,903,317	$6,291,003	$9,436,505
16	Electrical	12.48	34.09	51.135	$5,616,000	$3,567,859	$5,351,789
	Basic Materials & Methods	11.76	32.12	48.179	$5,291,897	$3,361,636	$5,042,454
	Testing	0.72	1.97	2.950	$324,001	$205,819	$308,729
	Total Building Costs	**100.00**	**273.13**	**409.695**	**$45,000,000**	**$28,585,786**	**$42,878,679**

Appendix D

RS Means	Square Foot Cost Estimate Report	Cost Works
Estimate Name:	**Saint Vincent Health Center** Erie , PA	
Building Type:	**Hospital, 2-3 Story with Face Brick with Concrete Block Back-up / Steel Frame**	
Location:	**ERIE, PA**	
Story Count:	**3**	
Story Height (L.F.):	**14**	
Floor Area (S.F.):	**104660**	
Labor Type:	**Union**	
Basement Included:	**Yes**	
Data Release:	**Year 2010 Quarter 3**	
Cost Per Square Foot:	**$231.95**	
Building Cost:	**$24,275,500**	

Costs are derived from a building model with basic components.

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

		% of Total	Cost Per S.F.	Cost
A Substructure		3.00%	$6.54	$684,000
A1010	Standard Foundations		$1.96	$205,500
A1030	Slab on Grade		$1.51	$158,000
A2010	Basement Excavation		$1.12	$117,500
A2020	Basement Walls		$1.94	$203,000
B Shell		15.10%	$32.78	$3,431,000
B1010	Floor Construction		$18.52	$1,938,000
B1020	Roof Construction		$2.01	$210,000
B2010	Exterior Walls		$8.68	$908,500
B2020	Exterior Windows		$1.49	$156,000
B2030	Exterior Doors		$0.29	$30,000
B3010	Roof Coverings		$1.79	$187,000
B3020	Roof Openings		$0.01	$1,500
C Interiors		19.30%	$41.72	$4,366,000
C1010	Partitions		$7.88	$825,000
C1020	Interior Doors		$10.29	$1,077,000
C1030	Fittings		$0.82	$85,500
C2010	Stair Construction		$1.22	$128,000
C3010	Wall Finishes		$6.93	$725,000
C3020	Floor Finishes		$8.59	$899,500
C3030	Ceiling Finishes		$5.98	$626,000
D Services		54.80%	$118.74	$12,427,000
D1010	Elevators and Lifts		$4.77	$499,500
D2010	Plumbing Fixtures		$27.08	$2,834,000
D2020	Domestic Water Distribution		$11.26	$1,178,500
D2040	Rain Water Drainage		$0.48	$50,500
D3010	Energy Supply		$4.07	$425,500
D3020	Heat Generating Systems		$2.78	$291,000
D3030	Cooling Generating Systems		$5.91	$618,500
D3090	Other HVAC Systems/Equip		$35.42	$3,707,000
D4010	Sprinklers		$2.75	$288,000
D4020	Standpipes		$0.67	$70,500
D5010	Electrical Service/Distribution		$0.86	$89,500
D5020	Lighting and Branch Wiring		$14.10	$1,475,500
D5030	Communications and Security		$4.63	$484,500
D5090	Other Electrical Systems		$3.96	$414,500
E Equipment & Furnishings		7.80%	$16.80	$1,758,000
E1020	Institutional Equipment		$10.28	$1,075,500
E1090	Other Equipment		$0.00	$0
E2020	Moveable Furnishings		$6.52	$682,500
F Special Construction		0.00%	$0.00	$0
G Building Sitework		0.00%	$0.00	$0
SubTotal		100%	$216.57	$22,666,000
Contractor Fees (General Conditions,Overhead,Profit)		5.00%	$10.83	$1,133,500
Architectural Fees		2.00%	$4.55	$476,000
Total Building Cost			$231.95	$24,275,500

Detailed Structural Systems Estimate

Saint Vincent Health Center project has a deep foundation system of 48” and 36” cased caissons. On the lower level there are concrete reinforced grade beams under the perimeter and interior walls. The slab on grade is a 4” reinforced mesh concrete slab. The total estimated cost of the Foundation system that I came up with is $1.267 Million. The tables below should the detailed breakdown of the estimate.

Floor Areas

Lower Level – 37,900 SF 12” concrete

Ground Floor – 37,900 SF 18ft x 24ft typical bay

1st Floor – 28,850 SF 18ft x 24ft typical bay

Roof/future 2nd Floor – 36ft x 24ft typical Bay

Foundation Slab & Grade Beams

4” concrete slab on grade

Total Area A = 37,900 SF

Slab Concrete = 1403.7 CY

Grade Beams 18”x42” Below Exterior walls, 16”x36” below Interior walls

Grade Beams Concrete = 238 CY

Deep Foundation Systems:

(2900) 48” cased caissons at unit cost of $245 per, so total of **$710,500**
(1767) 36” cased caissons at $150 per unit = total of **$265,050**

Foundations & Lower Level Estimate

Foudation System:	Item Description	Quanity	Unit	Unit Cost	Total
Deep Foundations	48" Cased Caissons	2900	VLF	$245	$710,500
	36" Cased Caissons	1767	VLF	$150	$265,050
Concrete Grade Beams	18" x 42" Perimeter Grade Beams	148	CY	$725	$107,300
	16" x 36" Interior Grade Beams	89	CY	$725	$64,525
Slab on Grade	4" thick slab w/ mesh reinforcing	38100	SF	$3.15	$120,015
				Total	**$1,267,390**

Saint Vincent’s new addition can be primarily broken up into 4 types of typical bays. I have labeled them Area A-D. Below is a description of each Area, followed by the estimate of the typical bays:

AREA A

Typical Bay: 18ft x 24ft:

- Beams = (4) W12x19 [24ft]
- Girders = (2) W16x26 [18ft]
- Columns = (4) W10x68

4” concrete slab on 2” compostite steel metal deck

Area = 432 SF

Yards = 180 ft^3 = 6.667 CY

Total Area A = **52,710 ft^2**

AREA A: Ground Floor & 1st Floor Typical Framing

AREA B

Typical Bay: 18ft x 24ft:

- Beams = (3) W14x22 [24ft] & (1) W16x40 [24ft] Exterior wall
- Girders = (2) W16x31 [18ft]
- Columns = (4) W10x54

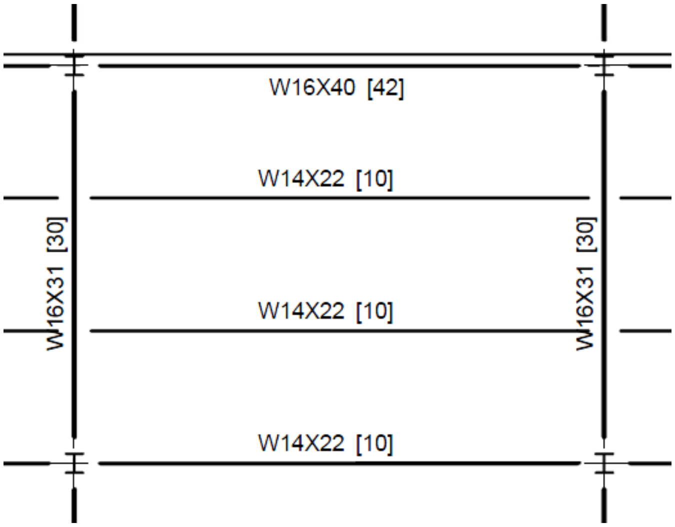
4” concrete slab on 2” compostite steel metal deck

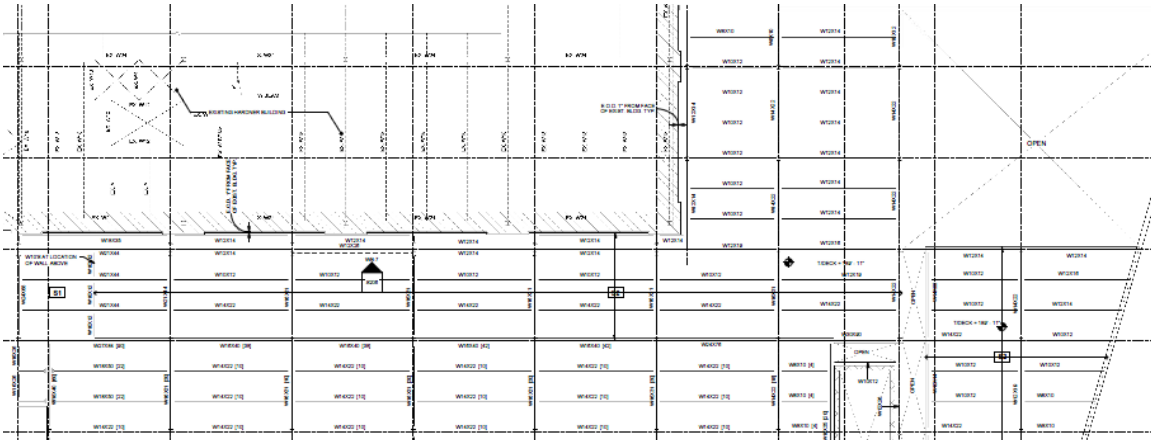
Area = 432 SF

Yards = 180 ft^3 = 6.667 CY

Total Area C = 7128 ft^2 + 5184 ft^2 + 1728 ft^2 = **14040 ft^2**

AREA B: Ground Floor & 1st Floor Typical Edge Framing





AREA C: Roof/ Future 2nd Floor

Typical Bay: 36ft x 24ft:

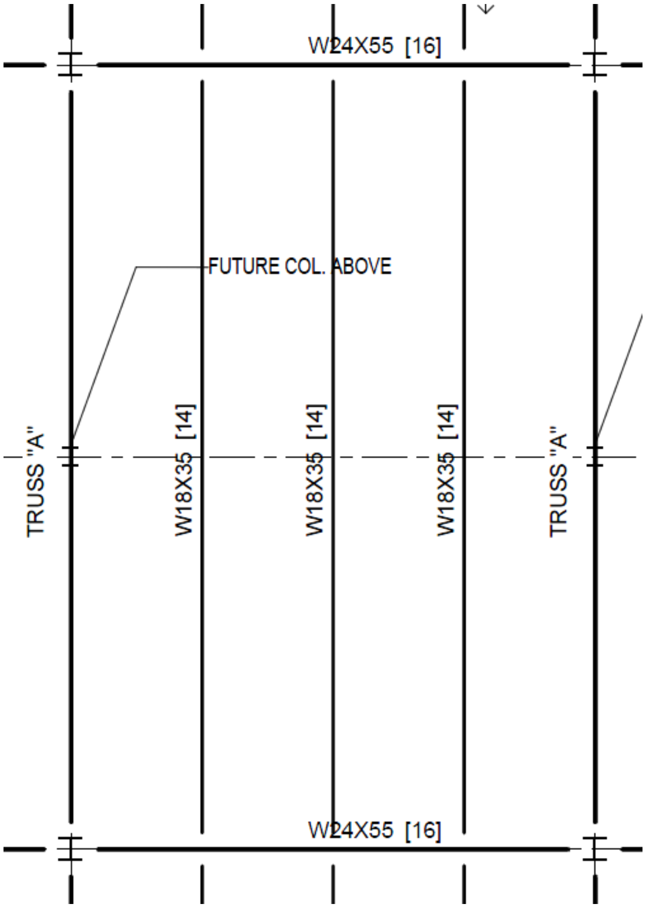
- Beams = (3) W18x35 [36ft]
- Beam/Truss = (2) Truss "A" [36ft]
- Girders = (2) W24x55 [24ft]
- Columns = (4) W12x65

4" concrete slab on 2" compostite steel metal deck

Area = 864 SF

Yards = 360 ft^3 = 13.333 CY

Total Area C = 12,960 ft^2



AREA D: Roof / Future 2nd Floor

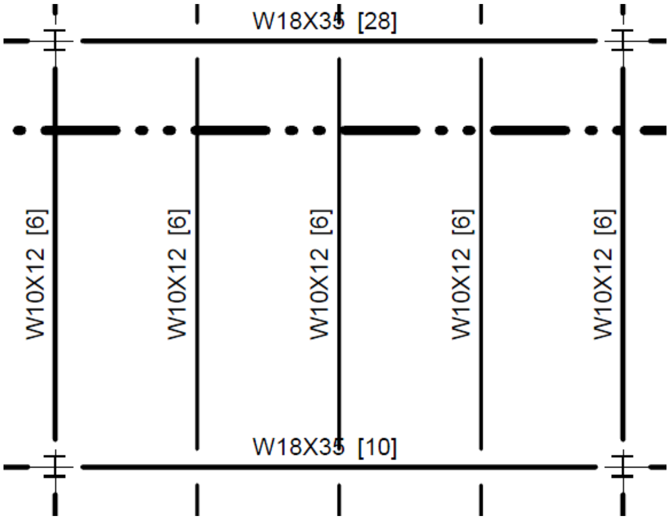
Typical Bay: 18ft x 24ft:

- Beams = (5) W10x12 [18ft]
- Girders = (2) W18x35 [24ft]
- Columns = (4) W10x54

4" concrete slab on 2" compostite steel metal deck

Area = 432 SF

Total Area: 15,890 ft^2



Steel Estimate for Typical Bays

Typical Bay	Steel Member	# of Members	Member Length (ft)	Unit	Quantity	Unit Cost	Total Cost/Area	Totals Cost/Area	
Area A	W12x19	3	24	L.F.	72	$33.42	$2,406.24	Total Cost Area A	$5,452.58
	W16x26	1	18	L.F.	18	$36.77	$661.86		
	W10x68	2	14	L.F.	28	$85.16	$2,384.48		
Area B	W14x22	2	24	L.F.	48	$36.83	$1,767.84	Total Cost Area B	$6,243.86
	W16x40	1	24	L.F.	24	$54.47	$1,307.28		
	W16x31	1	18	L.F.	18	$43.57	$784.26		
	W10x54	2	14	L.F.	28	$85.16	$2,384.48		
Area C	W18x35	3	36	L.F.	108	$50.01	$5,401.08	Total Cost Area C	$13,028.76
	Truss "A"	1	36	L.F.	36	$73.88	$2,659.68		
	W24x55	1	24	L.F.	24	$97.66	$2,343.84		
	W12x65	2	14	L.F.	28	$93.72	$2,624.16		
Area D	W10x12	4	18	L.F.	72	$25.46	$1,833.12	Total Cost Area D	$5,417.84
	W18x35	1	24	L.F.	24	$50.01	$1,200.24		
	W10x54	2	14	L.F.	28	$85.16	$2,384.48		

Above is the Steel Estimate for the typical bays. This estimate is done based on the steel members used in each bay. The table below is the a detailed typical bay estimate that includes the area of the typical bay, the total area of the bay in the building, the cost of concrete and steel per area type.

Typical Bay Estimate

Areas			Concrete (CY)/SF			
Typical Bay	Typical Area (SF)	Total Area (SF)	Concrete (CY)/SF	Total Concrete (CY)	Concrete Cost/Typical Area	Total Concrete Cost
Area A	432	52710	0.01543	813.4	$1,054.33	$128,642.90
Area B	432	14040	0.01543	216.7	$1,054.33	$34,265.73
Area C	864	12960	0.01543	200.0	$1,054.33	$15,814.95
Area D	432	15890	0.01543	245.2	$1,054.33	$38,780.80
	Totals:	**95600**		**$1,475.31**		**$217,504.37**

	Metals					
Typical Bay	Steel Cost/SF	Steel Cost/ Typical Area	Total Steel Cost	Metal Decking Cost/SF	Metal Decking Total Cost	**Total Cost**
Area A	$12.62	$5,452.58	$665,290	$2.18	$114,907.80	**$908,841**
Area B	$14.45	$6,243.86	$202,925	$2.18	$30,607.20	**$267,798**
Area C	$15.08	$13,028.76	$195,431	$2.18	$28,252.80	**$239,499**
Area D	$12.54	$5,417.84	$199,281	$2.18	$34,640.20	**$272,702**
			$1,262,929		**$208,408.00**	**$1,688,841**

The Structural System for the above ground structure I estimated will cost $1.69 Million. This price includes the steel members, metal decking and the concrete slabs. Below is the Structural estimate summary that includes the deep foundations, grade beams, slab on grade, and all the typical bays A-D. This total including waste is approximately $3.25 Million.

Structural Estimate Summary

Structural System	Cost/Building SF	Total Cost
Deep Foundations	$9.38	$975,550
Grade Beams	$1.65	$171,825
Slab on Grade	$1.15	$120,015
Area A	$8.74	$908,841
Area B	$2.57	$267,798
Area C	$2.30	$239,499
Area D	$2.62	$272,702
TOTAL	**$28.43**	**$2,956,230**
Add Waste 10%	**$2.84**	**$295,623**
GRAND TOTAL	**$31.27**	**$3,251,853**

General Conditions Estimate

My estimated General Conditions for the Saint Vincent Health Center cost would be slightly over $1.1 million. This cost includes Staff, temporary utilities, equipment, and misc. cost. I also included a total savings that the CM is saving because of using Saint Vincent's building and utilities. That savings is approximately $ 162,700.

For the Supervision and personnel estimate, I estimated that the senior superintendent and the project manager will be working on this project full-time whereas the others, vice president, engineer and safety coordinator will be work a portion of the time. The estimated total that I came up with for the CM staff is based on a 100 week project with 10 addition weeks dealing with pre-construction work. The estimated total for the staff will be around $750,000.

Supervision and Personnel

Line Item	Quantity	Units	Unit Price	Total
Vice President	85	Week	$2,225.00	$189,125
Senior Project Manager	110	Week	$2,200.00	$242,000
Project Engineer	50	Week	$1,900.00	$95,000
Senior Superintendent	100	Week	$2,050.00	$205,000
Safety Coordinator	100	Week	$150.00	$15,000
			TOTAL	**$746,125**

Below is my construction facilities and equipment estimate. Saint Vincent is providing the on-site office space in their existing Hardner Building that is adjacent to the site. Because of this there are some savings that normally wouldn't be on a project, such as field office trailer set-up, removal and trailer rental cost. I have made a table of all the cost saving that Saint Vincent is providing. The total cost of the Facilities and Equipment is an estimated $215,000.

Construction Facilities and Equipment

Line Item	Quantity	Units	Unit Price	Total
Field Office Trailer Set-up	-1	LS	$2,000.00	-$2,000
Field Office Trailer Rental	-20	Month	$1,000.00	-$20,000
Field Office Trailer Removal	-1	LS	$2,225.00	-$2,225
Construction Site Fence	20	Month	$325.00	$6,500
Storage Trailers	20	Month	$130.00	$2,600
Survey/Layout (Urban Eng.)	1	LS	$20,000.00	$20,000
Testing & Inspection(Urban)	1	LS	$75,000.00	$75,000
Tools/Equipment	1	LS	$50,000.00	$50,000
Trucking	20	Month	$1,500.00	$30,000
Fire Extinguishers	20	Month	$75.00	$1,500
Field Copier/Fax/Printer	20	Month	$200.00	$4,000
Computer/LAN Equipment	20	Month	$250.00	$5,000
Mobile Phones	20	Month	$75.00	$1,500
Signage	1	LS	$3,000.00	$3,000
Dumpsters	100	EA	$400.00	$40,000
			TOTAL	**$214,875**

The temporary utilities are all provided by Saint Vincent. The offices are in the adjacent Hardner building that saves cost from using trailers and electric cost. Saint Vincent is also providing the temporary power and water for the project. They are just connecting into the existing power and water source of the Hospital Complex. The only cost EE Austin will have in this department is temporary/portable toilets which I estimated will be around $250/month so a total of $5,000. The total cost of temporary utilities compared to a normal project is a savings of $ 133,475.

Temporary Utilities

Line Item	Quantity	Units	Unit Price	Total
Field IT/Network Set-up	-1	LS	$2,225.00	-$2,225
Field Telephone Hook-up	-1	LS	$1,000.00	-$1,000
Field Telephone Service	-20	Month	$100.00	-$2,000
Temporary Power Installation	-1	LS	$10,000.00	-$10,000
Temporary Power Consumption	-20	Month	$6,000.00	-$120,000
Temporary Water	-1	LS	$2,050.00	-$2,050
Temporary Toilets	20	Month	$250.00	$5,000
Potable Water	-20	Month	$60.00	-$1,200
			TOTAL	**-$133,475**

The miscellaneous cost of this project includes insurance, permits, clean-ups and misc. labor. In Erie, you have to estimate for snow removal labor cost; because in Erie, PA they can get multiple feet of snow overnight so there needs to be estimated cost for snow removal. The total estimated cost that I came up with for these miscellaneous costs is approximately $140,250.

Miscellaneous Costs

Line Item	Quantity	Units	Unit Price	Total
Occupancy Permit	1	LS	$1,000.00	$1,000
Trade Permits	1	LS	$1,000.00	$1,000
Progress Photographs	20	Month	$15.00	$300
Document Reproduction	1	LS	$5,000.00	$5,000
Travel Expenses (Staff Vehicles)	20	Month	$500.00	$10,000
Delivery/Shipping Expenses	20	Month	$150.00	$3,000
Clean-up Expenses	100	Week	$100.00	$10,000
Safety Labor	240	HR	$45.00	$10,800
Snow Removal Labor	120	HR	$45.00	$5,400
Health Screenings	10	EA	$175.00	$1,750
Office Furniture	1	LS	$2,000.00	$2,000
Misc. Field Expenses	20	Month	$500.00	$10,000
Insurance	1	Job	$80,000.00	$80,000
			TOTAL	**$140,250**

There are General Conditions Savings that I estimated because of Saint Vincent provided office space and temporary utilities. The offices are in the adjacent Hardner building that saves cost from using trailers and electric cost. Saint Vincent is also providing the temporary power and water for the project. They are just connecting into the existing power and water source of the Hospital Complex. The total estimated saving based on a similar project is approximately $ 162,700.

General Conditions Savings

Line Item	Quantity	Units	Unit Price	Total
Field IT/Network Set-up	-1	LS	$2,225.00	-$2,225
Field Telephone Hook-up	-1	LS	$1,000.00	-$1,000
Field Telephone Service	-20	Month	$100.00	-$2,000
Temporary Power Installation	-1	LS	$10,000.00	-$10,000
Temporary Power Consumption	-20	Month	$6,000.00	-$120,000
Temporary Water	-1	LS	$2,050.00	-$2,050
Field Office Trailer Removal	-1	LS	$2,225.00	-$2,225
Potable Water	-20	Month	$60.00	-$1,200
Field Office Trailer Set-up	-1	LS	$2,000.00	-$2,000
Field Office Trailer Rental	-20	Month	$1,000.00	-$20,000
			TOTAL SAVINGS	**-$162,700**

Total General condition cost are approximately $1.106 million.

General Conditions Summary

Line Item	Quantity	Units	Unit Price	Total
Supervision and Personnel	100	Week	$7,461.25	$746,125
Constr. Facilities & Equipment	100	Week	$2,148.75	$214,875
Temporary Utilities	100	Week	$50.00	$5,000
Miscellaneous Cost	100	Week	$1,402.50	$140,250
TOTAL	**100**	**Week**	**$11,062.50**	**$1,106,250**

ANALYSIS #1:

SCHEDULE REDUCTION/RE-SEQUENCING PHASING

Problem Statement

This is a three phase project: Phase 1 is new Ambulance Entrance Addition, which is currently under construction. Phase II is Temporary connector corridor along the west side of the site so the existing connector can be removed to allow for access to the new building. Phase III is the new inlet building itself. With three phases, a lot of coordination must be done to not fall behind schedule. A critical sequencing issue is not to interrupt flow of hospital operations at ED and movement between the existing hospital and the MOB (Medical Office Building / Hardner Building) to the North.

The new emergency ambulance entrance (Phase I) is being constructed now so until it is complete, ambulances and patients will continue to use the existing emergency department entrance off of 24th Street. During Phase II, when Phase I is all complete, all ED traffic (patients and ambulances) will use the new Ambulance Entrance for access to the Emergency Department (ED), down the connector corridor. During Phase III, after the temporary connector on the west side is complete at the end of Phase II, pedestrian ED traffic will use the entrance at the southwest corner of that new temporary connector. Ambulance traffic will continue using the new Ambulance Entrance.

The proposed sequence has multiple phases with demolition work overlapping new construction activities throughout the entire project schedule. Phased occupancies are planned for the Emergency entrance, connecting corridor and In-Fill Addition and the Existing Hospital to accommodate Saint Vincent's requirements. This scenario creates potential problems with trade coordination, contractor delays. There will be several contractors switching between renovation, demolishing and new construction work which will make coordination and schedule understanding extremely difficult. Ultimately, the overall project schedule starts with work on the new entrance for the emergency department and ends with the construction of the In-Fill Building, along with temporary construction and demolition in between.

Research Method

The goal of this analysis is to perform an in-depth re-structuring of the project schedule to reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. A critical path schedule and a detailed schedule will show the reduction in completion date.

Methodology

- Interview Construction project team for sequencing and trade coordination issues
- Research material availability and resource leveling to determine production capabilities
- Contact subcontractors to discuss activity durations and man-power requirements

- Re-sequence schedule to reduce schedule length but doing unrelated work simultaneously
- Evaluate trade coordination and develop sequencing diagrams for work flow
- Analyze schedule, cost and constructability
- Analyze site congestion and trade coordination improvements
- Calculate savings in general conditions and Saint Vincent's revenue produced due to reduced schedule

Findings

This analysis is to perform an in-depth re-structuring of the project schedule to reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. The best way to accelerate the schedule would be by working on two phases simultaneously. This could be done during phase 1 and 2. By starting construction on the temporary corridor (Phase2) during the construction of the new emergency entrance (Phase 1). This would save approximately 3 months in the schedule if Phase 1 and 2 were being worked on simultaneously.

The only downside of this is dealing with being more workers on an already congested site. In Appendix E are the schedules, one is the original critical path schedule and the other is the accelerated schedule. The accelerated schedule is what could be like if Phase 1 & 2 were being construction simultaneously. This schedule allows the project to finish 3 months earlier than the original turnover date. That would help both Saint Vincent and EE Austin. The original occupancy date was estimated around June 26, but with this reduction the new occupancy date could be around March 11th.

Cost Reduction (Savings)

Cost reduction is always going to happen when projects are finished several weeks ahead of schedule. Things such as utilities and rented equipment can be returned earlier, which saves money. Another large savings is the personal savings of not having project managers, engineers and superintendents on the project any longer. They can move on to the next job. Below are tables showing the estimated savings from finishing the project 13 weeks early. The savings for General conditions are around $32,300, and the savings of personal on the project can be up to $110,000. This is a large savings for reducing the schedule.

Another factor that will make Saint Vincent pushing for this schedule reducing is the revenue they will make when the new operation and patient rooms are up and running. This will allow Saint Vincent to house more patients but also will make more money but having more people. I talked with Saint Vincent to try to get a rough estimate of how much revenue the estimated will come from the new addition and these new rooms but they could not share that information with me. If I had the guess it would be over several hundred thousand over those 13 weeks. So that is extra money Saint Vincent could make if the project finished earlier than anticipated.

SAVINGS FOR SCHEDULE REDUCTION

General Conditions Savings

Line Item	Quantity	Units	Unit Price	Total
Field Telephone Service	3	Month	$100.00	$300
Temporary Power Consumption	3	Month	$6,000.00	$18,000
Potable Water	3	Month	$60.00	$180
Field Office Trailor Rental	3	Month	$1,000.00	$3,000
Misc. Field Expenses	3	Month	$500.00	$1,500
Clean-up Expenses	13	Week	$100.00	$1,300
Temporary Toilets	3	Month	$250.00	$750
Construction Site Fence	3	Month	$325.00	$975
Trucking	3	Month	$1,500.00	$4,500
Fire Extinguishers	3	Month	$75.00	$225
Field Copier/Fax/Printer	3	Month	$200.00	$600
Computer/LAN Equipment	3	Month	$250.00	$750
Mobile Phones	3	Month	$75.00	$225
			TOTAL SAVINGS:	**$32,305**

Supervision and Personnel Savings

Line Item	Quantity	Units	Unit Price	Total
Vice President	13	Week	$2,225.00	$28,925
Senior Project Manager	13	Week	$2,200.00	$28,600
Project Engineer	13	Week	$1,900.00	$24,700
Senior Superintendent	13	Week	$2,050.00	$26,650
Safety Coordinator	13	Week	$150.00	$1,950
			TOTAL SAVINGS:	**$110,825**

Conclusions and Recommendations

The proposed sequence has multiple phases with demolition work overlapping new construction activities throughout the entire project schedule. Phased occupancies are planned for the Emergency entrance, connecting corridor and In-Fill Addition and the Existing Hospital to accommodate Saint Vincent's requirements. Ultimately, the overall project schedule starts with work on the new entrance for the emergency department and ends with the construction of the In-Fill Building, along with temporary construction and demolition in between.

The in-depth re-structuring of the project schedule and phasing can reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. The best way to accelerate the schedule would be by working on two phases simultaneously. This could be done during phase 1 and 2. By starting construction on the temporary corridor (Phase2) during the construction of the new emergency entrance (Phase 1). This would save approximately 3 months in the schedule if Phase 1 and 2 were being worked on simultaneously.

The savings that could happen if this project finished several weeks ahead of schedule could help Saint Vincent as well as the project team. Things such as utilities and rented equipment can be returned earlier, which saves money. Another large savings is the personal savings of not having project managers, engineers and superintendents on the project any longer. They can move on to the next job. Above are the tables showing the estimated savings from finishing the project 13 weeks early. The savings for General conditions are around $32,300, and the savings of personal on the project can be up to $110,000. Saint Vincent could also start using the new patient and operating rooms. By doing this, it will create a huge revenue estimated anywhere around a few hundred thousand.

I recommend that Saint Vincent and the project team take these actions and work on phase 1 and 2 simultaneously. Although there will be a need for more quality workers, and the site will be more congested, I still think this is something worth doing. Reducing the schedule by 13 weeks and saving thousands of dollars makes it worth it for project.

Resources & Special Thanks To:

Saint Vincent Health Center

EE Austin’s Project Team

Saint Vincent Project Team

Penn State AE Faculty

Dr. David Riley – CM Advisor

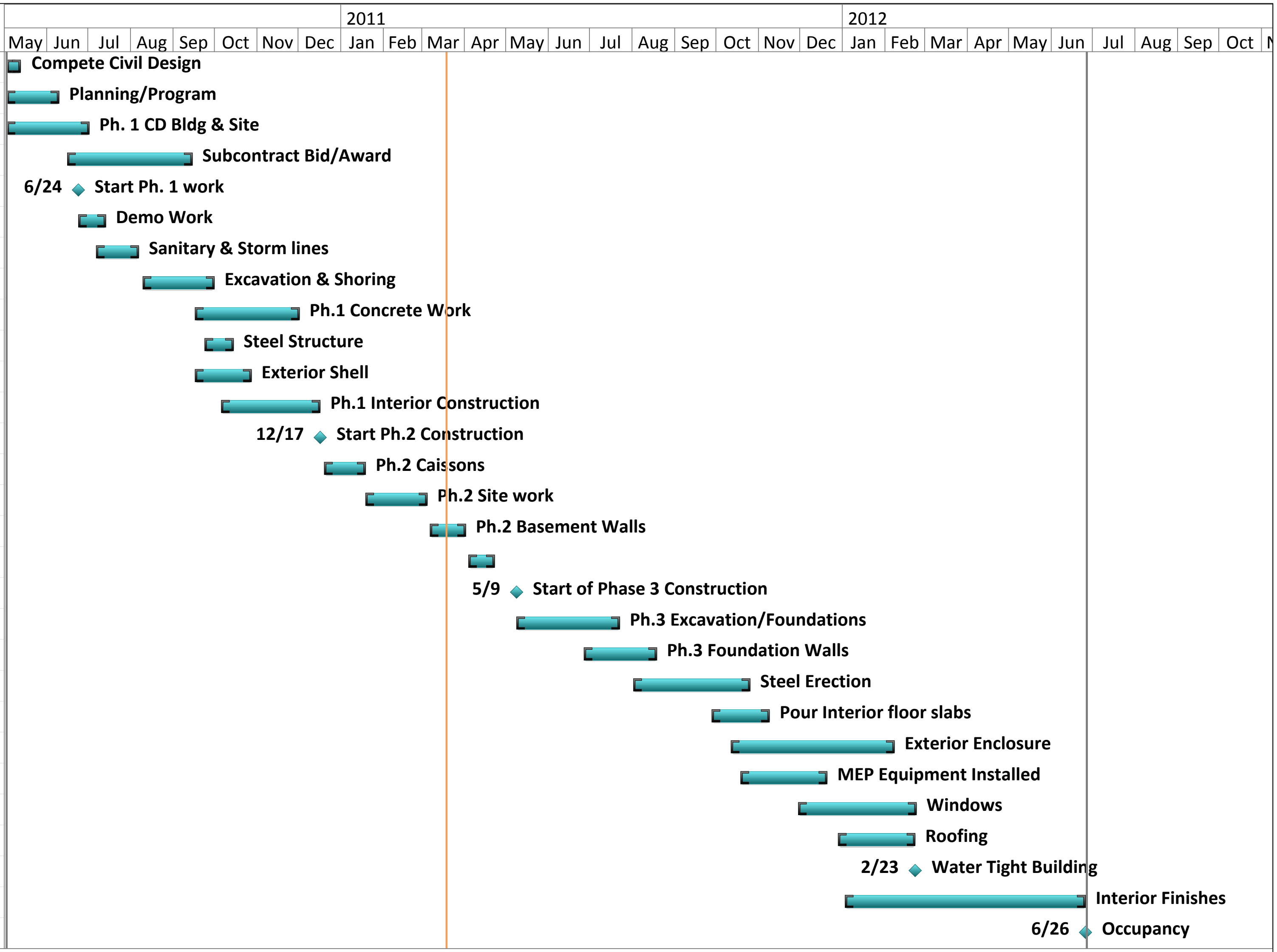
APPENDIX E

Critical Path Schedule

&

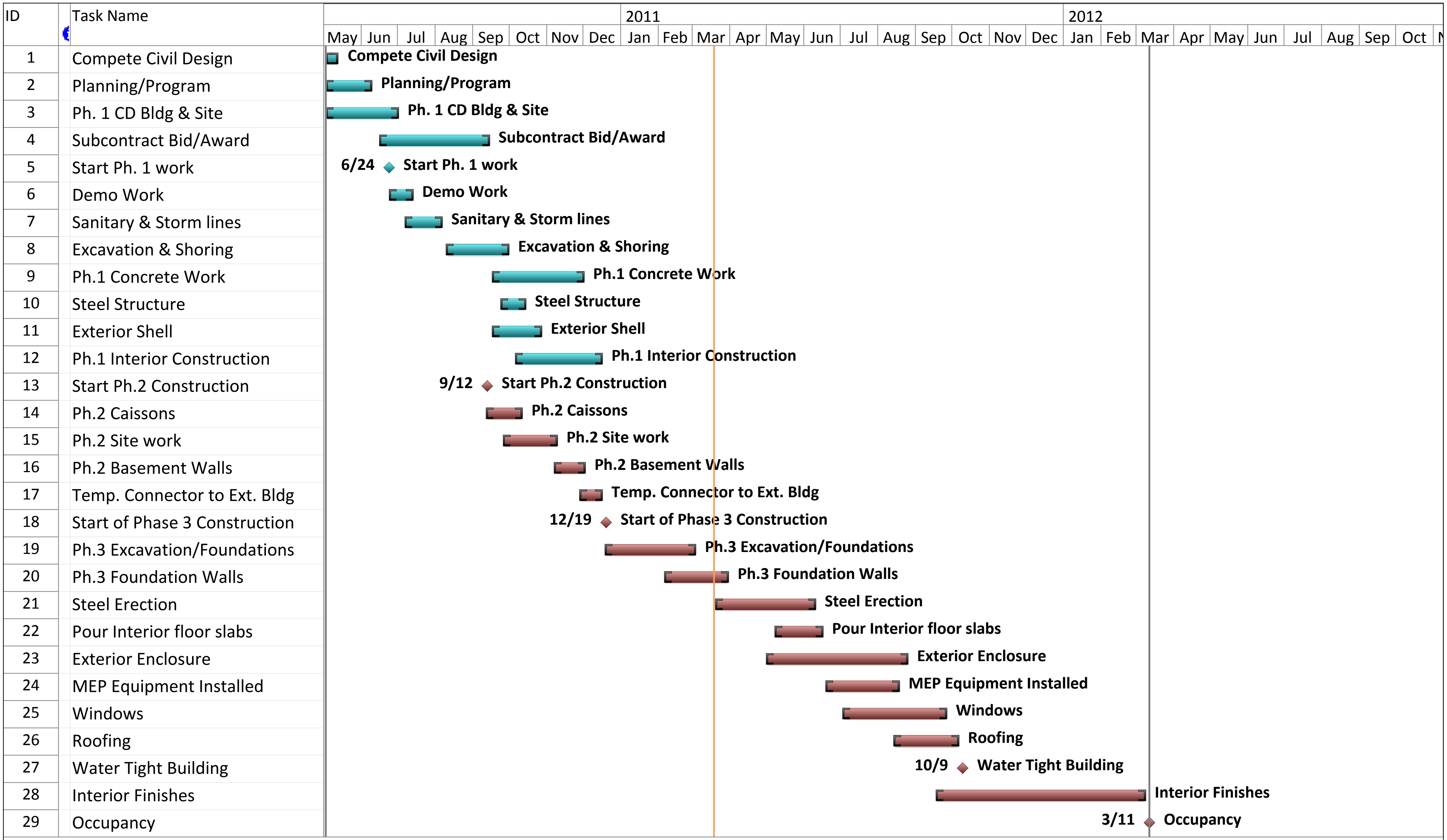
Accelerated Schedule

ID	Task Name
1	Compete Civil Design
2	Planning/Program
3	Ph. 1 CD Bldg & Site
4	Subcontract Bid/Award
5	Start Ph. 1 work
6	Demo Work
7	Sanitary & Storm lines
8	Excavation & Shoring
9	Ph.1 Concrete Work
10	Steel Structure
11	Exterior Shell
12	Ph.1 Interior Construction
13	Start Ph.2 Construction
14	Ph.2 Caissons
15	Ph.2 Site work
16	Ph.2 Basement Walls
17	Temp. Connector to Ext. Bldg
18	Start of Phase 3 Construction
19	Ph.3 Excavation/Foundations
20	Ph.3 Foundation Walls
21	Steel Erection
22	Pour Interior floor slabs
23	Exterior Enclosure
24	MEP Equipment Installed
25	Windows
26	Roofing
27	Water Tight Building
28	Interior Finishes
29	Occupancy



Project: Tech 3 Critical Path Sched
Date: Sat 3/19/11

Task	▬	External Milestone	◆	Manual Summary Rollup	▬
Split	┈	Inactive Task	▭	Manual Summary	▬
Milestone	◆	Inactive Milestone	◇	Start-only	[
Summary	▬	Inactive Summary	▭	Finish-only	]
Project Summary	▬	Manual Task	▬	Deadline	↓
External Tasks	▬	Duration-only	▬	Progress	▬



ID	Task Name
1	Compete Civil Design
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11	Exterior Shell
12	Ph.1 Interior Construction
13	Start Ph.2 Construction
14	Ph.2 Caissons
15	Ph.2 Site work
16	Ph.2 Basement Walls
17	Temp. Connector to Ext. Bldg
18	Start of Phase 3 Construction
19	Ph.3 Excavation/Foundations
20	Ph.3 Foundation Walls
21	Steel Erection
22	Pour Interior floor slabs
23	Exterior Enclosure
24	MEP Equipment Installed
25	Windows
26	Roofing
27	Water Tight Building
28	Interior Finishes
29	Occupancy

Project: Accelerated Schedule.mp
Date: Sat 3/19/11

Task	▬	External Milestone	◆	Manual Summary Rollup	▬
Split	┈	Inactive Task	▭	Manual Summary	▬
Milestone	◆	Inactive Milestone	◇	Start-only	[
Summary	▬	Inactive Summary	▭	Finish-only	]
Project Summary	▬	Manual Task	▬	Deadline	⇩
External Tasks	▬	Duration-only	▬	Progress	▬

Analysis #2: Brick Facade

Architectural Precast Concrete Wall Panels vs. Masonry Brick Veneer

Structural Breadth

Problem Statement

The hand-laid utility brick façade is a very common exterior wall type, however caused several problems on site with the detail of the through-wall flashing and drip edge, as well as the application of a spray-on fluid applied vapor barrier. This caused several schedule delays, and had potential for coordination and site logistic issues. The hand laid brick takes a considerable amount of time to construct, takes up room with the scaffolding, and leaves room for error between trades. Because the exterior enclosure milestone was required to begin interior fit-outs, accelerating the façade construction would keep the interior finishes from being delayed. Using an alternative to the masonry brick veneer such as architectural precast concrete panels may offer the same aesthetic quality and functional performance while increasing the speed of construction.

Background

A hand-laid brick exterior wall system requires a high amount of detail and can be a complex wall system to install. The brick wall may also require a large amount of scaffolding and area near the building envelope during the installation process. Precast systems can eliminate the need for a mortar station and constant re-stocking of brick for installation. There are a large amount of workers required to keep the brick installation moving along, which increases the need for safety and coordination of manpower.

Pre-fabricated systems are typically higher quality due to the ability to construct them in a controlled environment. On-site time can be reduced compared to stick-built construction, and prefabricated masonry may eliminate the need for cold weather construction practices and on-site scaffolding.

Precast exterior facades reduce labor costs and installation time, despite generally more expensive offsite prefabrication costs. The majority of preparation for a precast façade can be done off-site in a climate controlled environment which can offer a high level of quality control. Additionally, a precast brick exterior façade can take the place of each individual part of the wall, acting as an entire wall system, and can reduce the number of detailing issues and installation issues that could occur in the field.

Some drawbacks to precast wall systems are that they are normally less flexible in design and aesthetic quality compared to a hand-laid brick wall. This means the proper selection of a system which can offer a high level of aesthetic quality is important. The design for the Phase 3 New Building required a match of the existing hospital features with an emphasis on a quality appearance and an exceedingly watertight enclosure.

The joints between the precast panels and exterior curtain walls require close attention and quality control. Precast systems have control joints between the panels, which require quality control inspections in the field during construction. To ensure these joints are properly closed with a quality seal, a successful mock-up would need to be constructed and tested for watertight assurance and quality aesthetic appeal.

Additionally, the precast wall panels will change the load to the structure which means checking the existing structure is important, and re-sizing the members might be necessary. The detail of connections to the exterior beams will need to be designed.

Research Method

Research began with gaining a better understanding of different precast brick wall systems available. This is conducted by studying literature and case studies of different systems. Once the appropriate system has been chosen for use and panel sizes are determined, structural calculations will be completed to determine if the precast system is a feasible option, or if the structure would need to be re-sized due to an increased load. A detail of the typical connection at exterior beams will also be determined.

Cost and schedule implications will be determined based on the unit cost of the precast system and erection times. Finally, quality control issues of the selected precast system will be discussed to determine if the precast system can offer similar or better quality than the traditional hand-laid exterior brick wall system.

Goal

The goal of this analysis will be to select an appropriate architectural precast wall system which can offer similar aesthetic quality and watertight functional quality as a hand laid exterior brick wall system. The structural implications will be determined through structural calculations of the load applied to the exterior composite beams connected to the precast panels. This analysis will also determine the resulting cost and schedule implications.

Analysis

To begin the analysis, research had been conducted into appropriate architectural precast wall systems. It was important to select a system that can reduce the number of through wall flashing detailing issues and installation issues that could occur in the field. Because the project called for a fluid applied vapor barrier applied over the exterior sheathing of the building which caused schedule delays, it was also important to select a system that eliminated the need of a fluid applied vapor barrier and exterior sheathing. The following criteria were used for the selection of an appropriate system:

- High Quality appearance
- High weatherproof performance

- Cost-Effective
- Reduced construction schedule
- Proximity of factory to project site

After considering the above criteria in selecting the appropriate system, the following product was selected for use in this analysis.

SlenderWall, by Easi-Set Industries, met all of the mentioned criteria. It is an architectural precast concrete and steel stud panel wall system which composes of an exterior surface of thin architectural brick veneer cast into 2-inches of high-strength reinforced architectural precast concrete. The inside surface of the panel is composed of 16 gauge, 6-inch galvanized steel studs vertically spaced at 2-foot centers. The architectural concrete is connected to the steel-stud frame with a connection system utilizing insulated, stainless-steel welded Nelson shear stud anchors. This panel's construction as a whole replaces brick veneer, vapor barrier, exterior sheathing, and exterior metal studs. Selecting Slender Walls also help with getting LEED silver rating because these panels optimize energy performance and are made from recycled and regional materials.

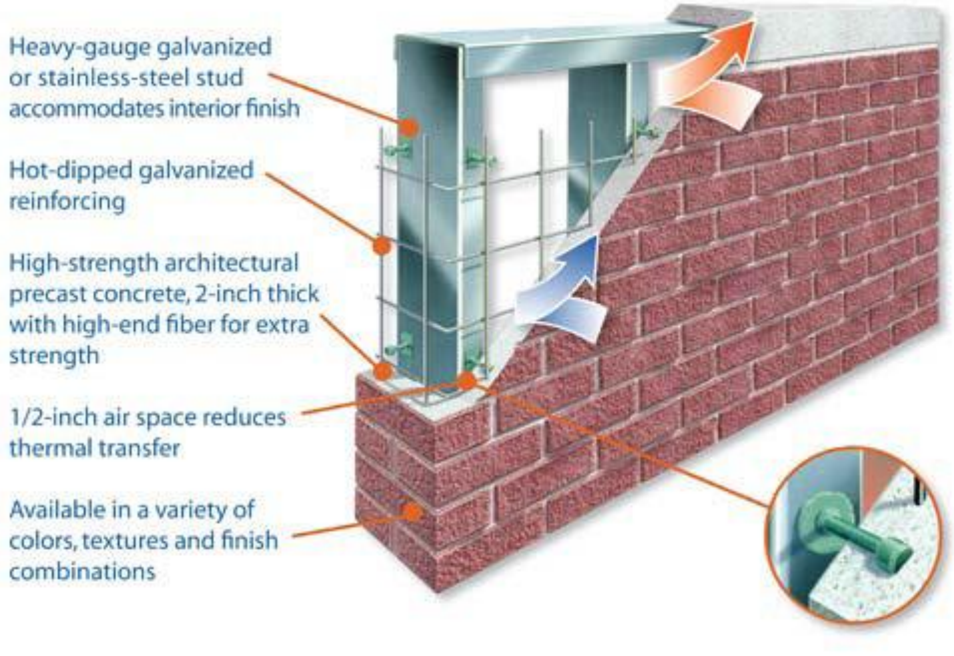


Figure 14, SlenderWall construction, from manufacturer's website http://www.slenderwall.com

Figure 15, Epoxy coated, stainless-steel welded Nelson shear stud anchors, from manufacturer's website http://www.slenderwall.com

After selecting the SlenderWall product, the panel sizes and layout on the building was first determined. Then a typical exterior beam supporting the exterior precast panel system in one of the heavier design loaded areas of the building will be structurally analyzed taking into account the panel weight. The most panel load per lineal foot occurs on the roof level beams because the second floor story height of 16-feet is the largest; making the second floor panels supported by the roof/future third floor beams the heaviest load by the panels.

Benefits of using SlenderWall products

- Reduces structural steel and foundation requirements when compared to conventional methods.
- Designed to endure structural challenges such as building frame lateral displacement, beam and floor deflection, column shortening and long-term creep.
- Eliminates corrosion by utilizing corrosion-proof and rust-proof materials.
- Specially formulated precast concrete mix provides a maintenance-free, waterproof panel that minimizes vapor infiltration.
- Major cost savings on cantilevered structure designs.

Determining Panel Sizes

In consultation with the manufacturer of the SlenderWall panel system, panel sizes and orientations were determined. The orientation of horizontal panels hung from the spandrel beam of the floor above has been determined to best suit the Phase 3 New building. It is recommended that panel sizes be constructed as large as possible, due to costs being on a fixed "per piece basis". According to the manufacturer, the most economically sized panels are generally 10-feet by 35-feet. Additional shipping fees generally occur when panels larger than 13-feet by 40-feet are being delivered due to delivery truck size restrictions. It is not recommended by the manufacturer to exceed 13-feet by 40-feet panels.

Because story heights on the Phase 3 New building are over 13-feet (ground floor is 12’6”, 1st is 16ft with an 8’ truss system between floors), the limiting length of the panels will be 13-feet wide in the horizontal direction.

Connection Detail

Changes to the exterior wall detail will have to be made when incorporating the alternative SlenderWall system. The change will require batt insulation to be installed within the steel framing attached to the SlenderWall panels, and the rigid insulation originally designed in the hand-laid brick system to be removed. The new detail shown below is a section of the typical connection made to the composite exterior spandrel beams provided by the manufacturer. A steel plate or angle is factory welded to the spandrel beam and bolted connections are made by the SlenderWall erection team as the panel is set in place.

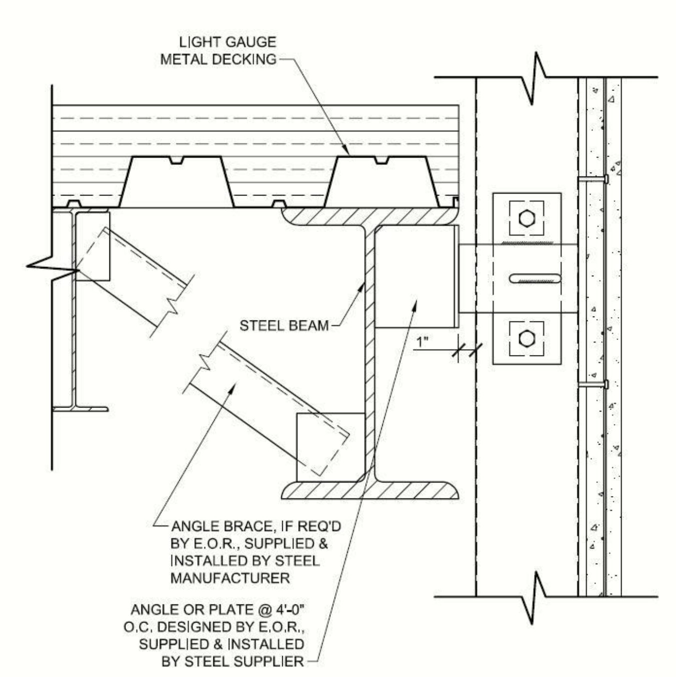


Figure 17, Standard connection detail at typical spandrel beam, from manufacturer’s website http://www.slenderwall.com

Structural Implications

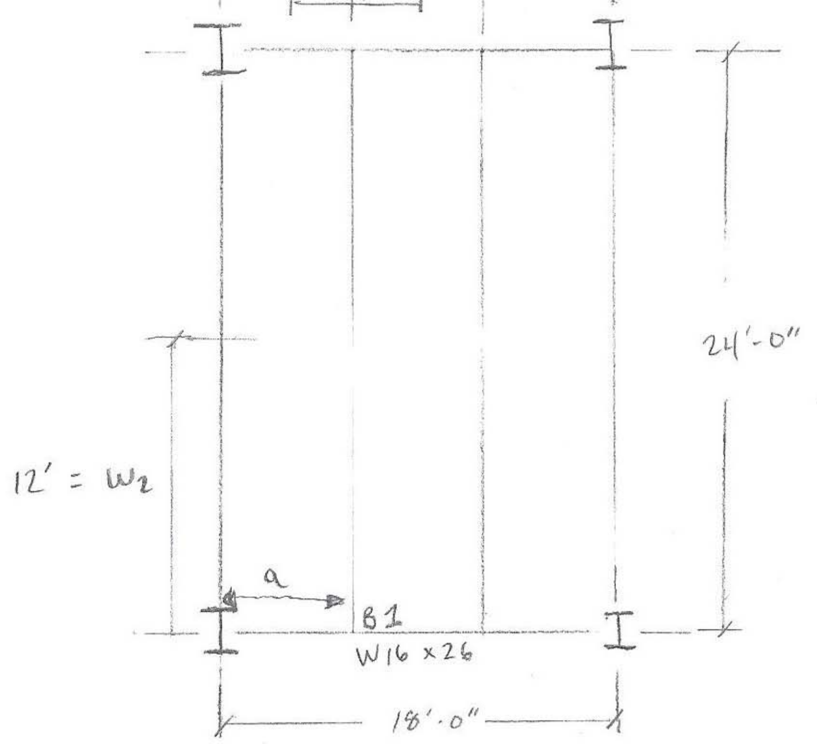
When a new exterior building enclosure system is proposed over the originally designed system, it is important to take into consideration the structural implications this change has on the structural design. Calculations can determine whether the size of the structure is sufficient or if it needs to be increased based on the alternative system weight.

The SlenderWall system is given to be 30 PSF unit weight, and using the second floor story height of 16-feet the system imposes 480 lb per lineal foot over the supporting exterior composite beams at the floor above. Calculations that follow are for a typical 1st level beam spanning 21 ft supporting the weight of panels on the second floor. It is understood that window units to be installed into the panels will be of lesser unit weight than the wall system, but to be conservative, the panels will be considered solid with no openings.

After performing the calculations for checking the composite beam design and deflection over a typical W 16 x 26 composite beam, it is determined that the beam is adequate in carrying the load of the precast panels. Therefore, it will be assumed by this structural analysis that no changes to the structural system will need to be implemented for supporting the weight of the SlenderWall precast panel system. Structural Breadth Calculations are as follows:

APPENDIX F

Structural Analysis Calculations



Highest story height = 22'

4000 PSI concrete

max water-cemetitous ratio: 0.45

4" concrete slab
on 2" composite metal deck
3/4" shear studs

Design of B1

LOADS:

DEAD

Superimposed = 10 PSF

Slab = 50 PSF

PANEL = 30 PSF (22' max) = 660 lb/ft

LIVE

OFFICE / PATIET ROOM = (50 PSF)

$w_1 = t_{w_1} (1.2\ DL + 1.6\ LL)$

$w_1 = 6' [1.2 (60\ PSF) + 1.6 (50)] = 912\ lb/ft$

$P = w_1 (t_{w_2}) = 912\ lb/ft\ (12')$

$P = 10{,}944\ lbs = 10.95\ kips$

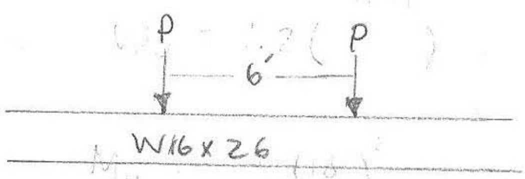
$W_p = (1.2)\ 660\ lb/ft = 792\ lb/ft\ (6\ ft)$

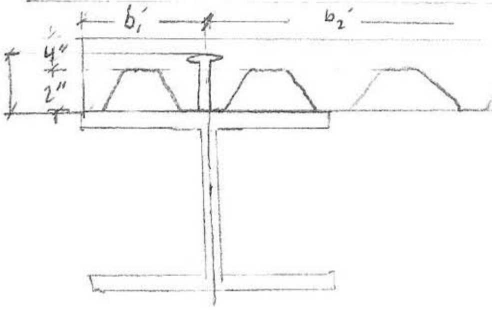
$= 4752\ lbs$

$= 4.75\ kips$

$V = P_{Total} = 10.95 + 4.75 = \boxed{15.70\ kips}$

$M = Pa = (15.7\ kips)(6\ ft) = \boxed{94.2\ ft.kips}$





EFFECTIVE FLANGE

$b_1' = 5.50$ in

$b_2 \le \frac{18'}{8} = 2.25'$ ← controls

or $\le \frac{24}{2} = 12$

$b_{eff} = 27" + 5.5" = 32.5"$

ASSUME $a = 1$ in

$Y_2 = 6" - \frac{1}{2}" = 5.5$ in

From AISC 13th Edition Table 3.21

3/4" shear stud → $Q_n = 21.2$ kips

CHECK W16 x 26 : Table 3-19

PNA @ 7 ← to Limit compression in concrete

$\phi M_N = 248'^k > M_U = 94.2'^k$ ∴ ok ✓

$\Sigma Q_n = 96^k$

CHECK ASSUMPTION $a = 1$ in

$$a = \frac{96000}{(0.85)(4000)(32.5)} = 0.869 \text{ in} < 1.0 \text{ in} \quad \therefore \text{ ok ✓}$$

# of shear studs = $96/21.2$ = 5 shear studs x 2 = 10 total studs/BEAM

CHECK DEFLECTION IN W16 x 26 :

CONSTRUCTION LOAD: $W = W_{D\,construction} + W_{L\,const.}$

SLAB: $W_{D\,const.} = 4.32$ Kips

20 PSF LL: $W_{L\,const.} = 1.44$ kips

$W = 4.32^k + 1.44^k = 5.76^k$

table 1-1 ; $I_X = 575$ in^4

$$\Delta = \frac{PL^3}{28EI_{LB}} = \frac{5.76^k (18)^3 (1728)}{28(29000)(575)} = 0.124 < \frac{l}{360} = \frac{18(12)}{360} = 0.60 \text{ in} \quad \therefore \text{ ok ✓}$$

LIVE LOAD: $W_L = 0.214$ k/ft

lower bound: $I_{LB} = 575$ in^4 ← table 3-20

$$\Delta_{LL} = \frac{1.44(18)^3(1728)}{28(29000)(595)} = 0.03004 < 0.60 \text{ in} \quad \therefore \text{ ok ✓}$$

TOTAL LOAD: $W = W_D + W_L +$ Panel $= 15.7$ kip $= P$

$$\Delta_{Total} = \frac{15.7^k (18')^3 (1728)}{28(29000)(575)} = 0.339 < \frac{l}{360} = \frac{18'(12')}{360} = 0.60 \text{ in} \quad \therefore \text{ ok ✓}$$

Quality Control Issues

Because Erie has various weather systems throughout the year, extreme weathering and waterproofing issues, as well as problems with the drip edge details and fluid applied vapor barrier, quality control of the exterior wall system is very important to look at. When choosing the proper precast exterior wall system to replace the hand laid utility brick, functional and aesthetic quality is a top priority in this case.

Traditional hand laid systems offer traditional and proven quality in construction, however the SlenderWall Architectural Precast Concrete and Steel Stud Building Panel offers Second Nature Architectural Precast Concrete Brick. This precast concrete brick is Class “A” and is approved by historical societies and architects for use of high profile architectural projects. The benefit to this system is there are no leaking brick joints, because the brick is cast into the precast concrete section. Slender Wall manufacturers work closely with architects, owners and designers to develop custom samples and designs to meet the proper quality requirements of the project. Successful mock-ups are made prior to installing the panels, and this is done to the architect’s requirements before accepting the final design of the system.

The Slender Wall system also provides a 100% thermal-break/air barrier. The 2-inch of concrete facing is secured to the steel framing by epoxy-coated stainless-steel Nelson anchors. This provides the concrete with response to thermal gradients independently because a ½ inch air space is left between the precast concrete and the stud frame. This provides a reduction in thermal transfer which could provide additional reduction in heating and cooling costs.

Joints and reveals are areas of big concern for leakage and infiltration of moisture between the panels. The SlenderWall is designed with a ¾-inch joint between panels and reveals can vary in size according to the design needs. The joint between panels can be finished with ¾-inch backer rod covered by a ½-inch layer of caulking to provide a watertight seal. A close quality-control inspection of these joints would need to occur during the construction of the panels in order to guarantee a high quality seal is maintained.

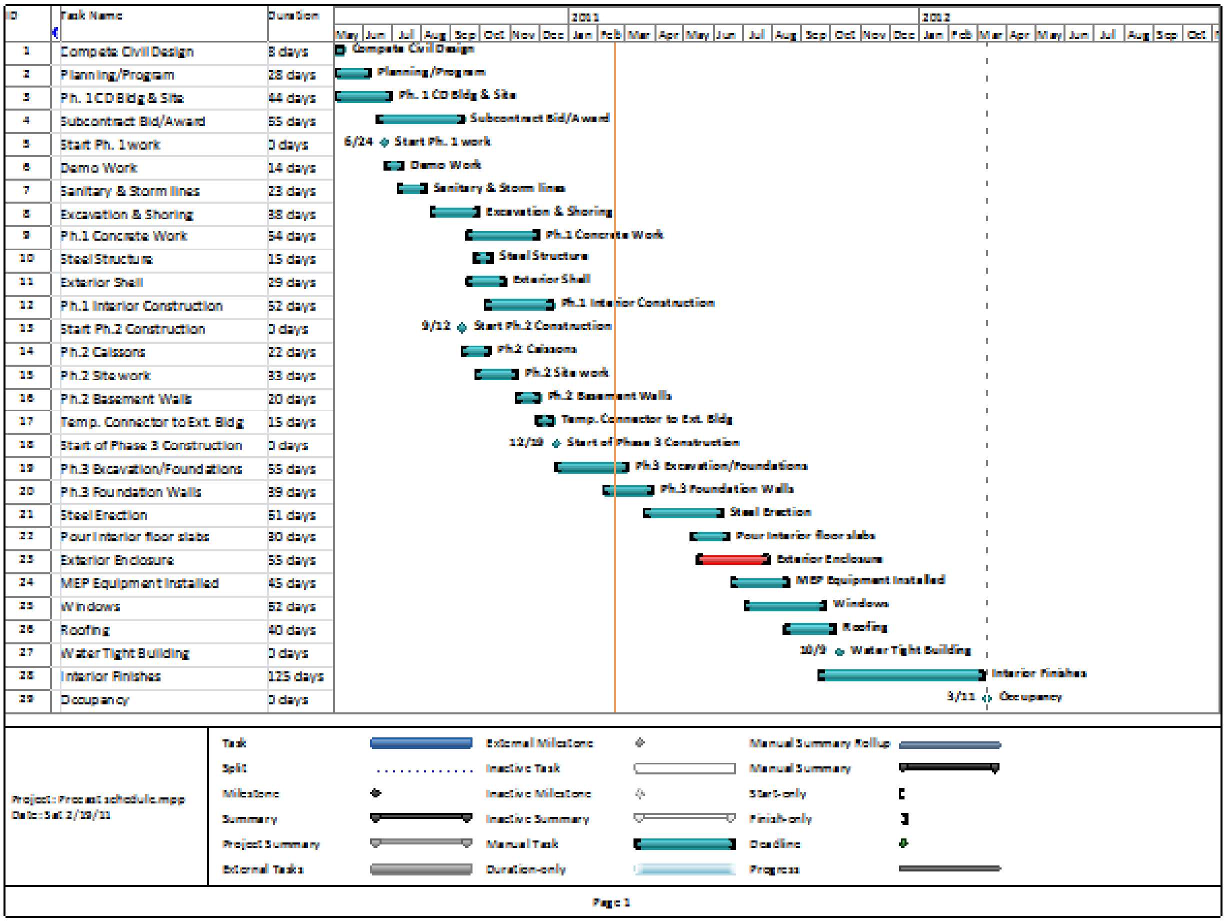
Schedule

The original exterior building enclosure schedule had duration of 85 days. The hand-laid system required exterior studs, exterior sheathing, and the fluid applied vapor barrier to be installed before the masonry contractor could begin setting the hand-laid brick. Additionally, the original building skin schedule required the exterior skin to be installed when the Roof framing was still being completed. This causes the schedule to be extended compared to working on the exterior as the structure goes up but it does help with site congestion and logistical issues when planning material deliveries and unloading.

When incorporating the SlenderWall system into the building skin schedule, durations were obtained from the SlenderWall manufacturer. Panels are typically installed using the precast contractor’s crane, which means the precast panels can be erected without major crane interruptions. The manufacturer of

SlenderWall estimates an average of 15 minutes from setting and installing per panel. Also, 28 items such as exterior studs, sheathing, and vapor barrier could be eliminated from the schedule because the SlenderWall already contains these items.

Based on the panel layout and sizes determined in this analysis and utilizing the durations and adding additional time for finishing the joints and caulking, a new schedule for the building enclosure was created. The same erection pattern as the original schedule was incorporated when planning the new schedule, which starts on the western end of the North elevation and moving counter-clockwise around the building. Although the duration of the exterior enclosure shortened, this will not impact the schedule in general. So the schedule isn't the most important aspect of this analysis. The Summary schedule below shows the change in exterior enclosure, but doesn't change the overall completion date due to there was several weeks of float time in the original schedule.



ID	Task Name	Duration
1	Compete Civil Design	8 days
2	Planning/Program	28 days
3	Ph. 1 CD Bldg & Site	44 days
4	Subcontract Bid/Award	55 days
5	Start Ph. 1 work	0 days
6	Demo Work	14 days
7	Sanitary & Storm lines	23 days
8	Excavation & Shoring	38 days
9	Ph.1 Concrete Work	54 days
10	Steel Structure	15 days
11	Exterior Shell	29 days
12	Ph.1 Interior Construction	52 days
13	Start Ph.2 Construction	0 days
14	Ph.2 Caissons	22 days
15	Ph.2 Site work	33 days
16	Ph.2 Basement Walls	20 days
17	Temp. Connector to Ext. Bldg	15 days
18	Start of Phase 3 Construction	0 days
19	Ph.3 Excavation/Foundations	55 days
20	Ph.3 Foundation Walls	39 days
21	Steel Erection	51 days
22	Pour Interior floor slabs	30 days
23	Exterior Enclosure	55 days
24	MEP Equipment Installed	45 days
25	Windows	52 days
26	Roofing	40 days
27	Water Tight Building	0 days
28	Interior Finishes	125 days
29	Occupancy	0 days

Accelerated Critical Path Schedule, No overall change (Red shows the change for SlenderWalls)

Cost

The cost of implementing the SlenderWall system as an alternative to the hand-laid system is an important factor in determining whether to utilize this alternative for the Phase 3 New Building. The material and labor costs associated with the SlenderWall are determined to be $40/SF, based on the manufacturer's cost data. When determining the cost of the hand-laid brick wall system, the cost of the exterior studs, exterior sheathing, fluid applied vapor barrier, utility brick masonry, miscellaneous finishing, and precast window and opening sills were all taken into account because the SlenderWall system includes and replaces all of those items.

Based on contractor's data and discussions with the masonry contractor, the original hand-laid brick wall system cost roughly $41/SF for the entire wall assembly. This is relatively close to the cost of the SlenderWall system. A comparison was done to determine the savings when utilizing the SlenderWall alternative system. Savings of roughly $15,384.00 were estimated when implementing SlenderWall as an alternative exterior façade wall system.

Panel Breakdown								
Panel #	**Quantity**	**Height (ft)**	**Width (ft)**	**Area (SF)**	**Weight (lbs)**	**Total Area (SF)**	**Cost/SF ($)**	**Total Cost**
A-1	12	17.33	5	86.65	2600	1039.8	$40.00	$ 41,592
A-2	16	14	5	70	2100	1120	$40.00	$ 44,800
B-1	21	8	6	48	1440	1008	$40.00	$ 40,320
B-3	7	9	6	54	1620	378	$40.00	$ 15,120
B-4	16	3.83	6	22.98	689	367.68	$40.00	$ 14,707
B-8	96	14	6	84	2520	8064	$40.00	$ 322,560
B-9	8	17.33	6	103.98	3119	831.84	$40.00	$ 33,274
C-1	8	17.33	3.33	57.71	1731	461.68	$40.00	$ 18,467
C-2	32	14	3.33	46.62	1399	1491.84	$40.00	$ 59,674
C-3	5	20	3.33	66.6	1998	333	$40.00	$ 13,320
F-1	3	17.33	2	34.66	1040	103.98	$40.00	$ 4,159
F-2	20	14	2	28	840	560	$40.00	$ 22,400
F-3	6	9	2	18	540	108	$40.00	$ 4,320
					Total:	**15868**	**Total:**	**$ 634,713**

System Cost Comparison

Prefabricated Precast

Item	Quanty	Unit	Unit Cost	Cost
Precast SlenderWall	15870	SF	$40.00	$634,800
Total			**$40.00**	**$634,800**

Normal Wall System

Item	Quanty	Unit	Unit Cost	Cost
Exterior Studs	15870	SF	$9.51	$150,924
Exterior Sheathing	15870	SF	$5.00	$79,350
Fluid Applied Vapor Barrier	15870	SF	$2.01	$31,899
Utility Brick Masonry Veneer	15870	SF	$16.77	$266,140
Miscellaneous Finishing	15870	SF	$1.25	$19,838
Precast Sills and Headers	15870	SF	$6.43	$102,044
Total			**$40.97**	**$650,194**

COST SAVINGS	**$15,394**

Conclusions and Recommendations

Based on the information presented in this technical analysis, it has been determined that implementing the alternative SlenderWall architectural precast concrete and steel stud panel wall system in lieu of the hand laid brick system would be a beneficial change to the exterior façade. The SlenderWall system allows the building skin schedule to be reduced by 20 days and begin after the superstructure is completed. When compared to the original schedule with the hand laid brick, which starts while the second floor slab is still being poured, the alternative SlenderWall system will greatly decrease site congestion during the superstructure phase. Also, the decision to use the SlenderWall system has been determined to reduce upfront costs by $15,394 when compared to using hand-laid brick.

The quality of the SlenderWall precast system would be the other determining factor in the decision to implement this alternative system to the hand-laid brick. While SlenderWall can offer high quality architectural precast brick to match the aesthetic requirements of the architect, it would still be viewed by some to have a “precast” look to the finished product due to joints between panels. However, a successful mock-up of the system can be completed before installation, and closely monitored installation and quality control checks on the finishing of the joints can assure a quality finish.

Additionally, the SlenderWall system would offer an exterior enclosure with no leaking brick joints, where the hand laid brick system may have imperfections in the mortar seal between individual bricks. The decision to implement the alternative exterior façade system would ultimately be up Saint Vincent Health Center. Depending on the acceptance of quality and aesthetic appeal, the SlenderWall system will provide a 20 day reduction in building skin installation while minimizing site congestion during the superstructure phase and offer an estimated $15,394 in upfront cost savings.

The Saint Vincent Heath Center Project Team do like keeping jobs in the area so that might be a reason why hand-laid masonry was used. Plus this would give more work for EE Austin and their carpenters. Because the overall schedule of the project isn't effected by the reduction in exterior enclosure, Saint Vincent and the project team might think the same savings that could save using SlenderWalls is NOT worth losing work with the locals. Local construction is the backbone of Erie and in an area of little construction work, it is necessary to keep as much of that work for local contractors. Ultimately, the decision is up to Saint Vincent and the project team.

Resources & Special Thanks To:

Saint Vincent Health Center

EE Austin's Project Team

Saint Vincent Project Team

Penn State AE Faculty

Dr. David Riley – CM Advisor

Analysis #3: ICRA PLAN

DEVELOP AN INFECTION CONTROL RISK ASSESMENT (ICRA) PLAN

Mechanical Breadth

PROBLEM IDENTIFICATION

There are many considerations in the design and construction or renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff. Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces.

An essential first step in a comprehensive Construction and Renovation Plan is an "infection control risk assessment" (ICRA). This assessment provides the foundation for long range planning, as well as for each phase of the project from concept to completion

RESEARCH GOAL

The goal of this analysis is to develop an ICRA plan for the hospital to keep a safe and clean conditions for the patients.

METHODOLOGY

- Research current ICRA typical plans
- Contact Infection control professionals
- Identify areas with highest risk
- Create diagram showing the areas with the most risk
- Developing plan to reduce and eliminate risks
- Check air handling system to see if it is large enough to pressurize building
- Analyze schedule, cost and constructability
- Analyze ICRA matrix

BACKGROUND

There are many considerations in the design and construction and renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff.

Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces. For example improper, ventilation design or maintenance has been associated with opportunistic infections such as Aspergillosis in highly immunocompromised populations such as bone marrow transplant patients. Airborne infections, such as tuberculosis have caused outbreaks among patients, workers and even visitors. The potential threats related to terrorism including anthrax, smallpox and the reported outbreaks of SARS among healthcare workers and patients has dramatically highlighted the importance of facility design for enhancing the control of infectious agents.

Planning for new construction or major renovation requires early consultation and collaboration among infection control professionals (ICPs), epidemiologists, architects, engineers, risk and safety professionals, and environment of care managers to ensure that infection prevention is built into the design. An essential first step in a comprehensive Construction and Renovation Plan is an "infection control risk assessment" (ICRA). This assessment provides the foundation for long range planning, as well as for each phase of the project from concept to completion – regardless of size or scope of the project.

Research Method

- Research current ICRA typical plans
- Contact Infection control professionals
- Identify areas with highest risk
- Create diagram showing the areas with the most risk
- Developing plan to reduce and eliminate risks
- Calculate CFM for typical room and for ground floor
- Analyze schedule, cost and constructability
- Analyze ICRA matrix
- Preform Mech. Breadth Analysis

Goal

The goal of this analysis is to develop an ICRA plan for the hospital to keep a safe and clean condition for the patients. It will identify areas of high risk and show precautionary measure that should be taking to reduce such ricks. I will use the floor plan layouts to show areas of higher risk. As part of my Mechanical Breadth, I will perform a few simple calculations to check the CFM and the loads of typical rooms and the ground floor of the hospital.

Analysis

The 1st step in the Infection Control Risk Assessment Matrix is selecting the type of construction activity the project will be doing. For the this case of Saint Vincent Health Center, this is type D construction. This type is major demolition and construction projects which includes but not limited to:

- activities which require consecutive work shifts
- requires heavy demolition or removel of a complete cabling system
- new construction

Since this project has both new construction and major demolition it definitely is a type D type construction activity.

The 2nd step in the ICRA matrix plan is to identify the "patient risk group" that will be affected by the construction. As shown in Appendix F, there are areas of lower risk, such as corridors and stair wells, along with areas of higher risk such as Emergency rooms and doctors' offices. The plan says if more than one risk group is affected then select the higher risk group. So that being said, I would categorize the group under the high risk.

Step three is the matrix of finding out the class of precautions from knowing the patient risk group (high) and knowing the construction project type (D) and the matrix says this construction project with Saint Vincent is a type IV patient risk.

Description of the Required Infection Control Precautions for Class IV

Requirements during Construction 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

Requirements upon Completion of Project

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. Remove isolation of HVAC system in areas where work is being performed.

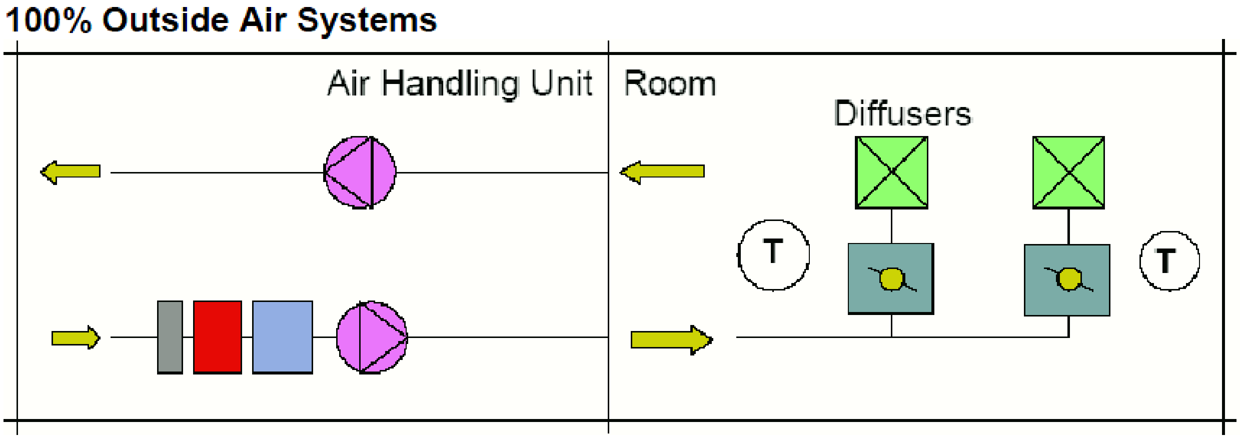
Mechanical Analysis

From ASHRAE 2007 Handbook: all health care rooms should be positively pressurized except:

- anesthesia gas storage room
- toilet room
- waiting rooms
- airborne infection isolation room
- darkroom
- laboratory
- cleaning storage rooms

Since the hospital should be positively pressurized compared to the outside construction space, the rooms that are already positively pressurized won't be a problem. On the other hand, those rooms listed above that are negatively pressurized will need to be less pressurized than the other hospital rooms but still be more pressurized than the construction space. So pos. pressurized hospital room > neg. pressurized hospital room > construction space.

Most of all the rooms need to have their exhausted air directly to the outside, so I'll assume that all rooms will do that for the calculations.



Calculations for the ventilation sensible and latent load for a typical hospital room:

Total Sensible Design Load = 1.08 x Total Supply CFM x (Room Temp – Supply Temp)

= 1.08 x 300 CFM x (70°F - 55°F)

= 4,860 BTU/hr

2. Ventilation air required per ASHRAE 62.1 – 2007 is 25 CFM/person for patient rooms.

Office spaces are not shown. To be on the conservative side, 25 CFM/person will be used for both the office and patient rooms.

3. Ventilation Air Required = 25 CFM/person x 6 persons = 150 CFM

4. Assume that ventilation air governs primary air supply right now and then check to see if it is greater than the latent load air requirement later.

5. Sensible Cooling Capacity of Primary Air = 1.08 x Vent. Air x (Room Temp – Supply Temp)

= 1.08 x 150 CFM x (70°F - 55°F)

= 2,430 BTU/hr

6. Sensible Cooling by Chilled Beam = Total Sensible Load – Sensible Capacity of Primary Air

= 4,860 BTU/hr – 2,430 BTU/hr

= 2,430 BTU/hr

7. Latent load in the room can be approximated by the general rule of thumb that each person gives off 200 BTU/hr of latent load.

8. Latent Load = 200 BTU/hr/person x 6 person = 1,200 BTU/hr

9. Latent Cooling Capacity of Primary Air = 4,840 x Vent. Air CFM x (WRoom – WPrimary)

= 4,840 x 150 CFM (0.009 – 0.007)

= 1,452 BTU/hr

10. The latent cooling capacity of primary air is greater than the latent load. Therefore, the ventilation air is adequate in supporting the latent load for the zone.

11. On average, a chilled beam can produce 1,000 BTU/hr/ft of sensible cooling capacity.

12. Chilled Beam Size = 2,430 BTU/hr ÷ 1,000 BTU/hr/ft = 2.43 ft Chilled Beam ≈ 3 ft Chilled Beam

13. Primary Air Reduction = 1 – (Primary Air CFM ÷ Total Current Supply CFM)

= 1 – (150 CFM ÷ 300 CFM)

= 50%

Typical patient room primary air reduction =74%

Calculations for the ventilation sensible and latent load for a total hospital floor:

Total volume for ground floor = 145,152 ft^2 x 14 ft story height = **2.032 Million ft^3**

From ASHRAE 2007 Handbook, the minimum air changes of outside air per hour are between 2 and 5. To simplify and assume worst case scenario, for the calculation I will make all rooms need 5 minimum air changes. The calculations for this are as followed:

(2.032 million ft^3)/(60 min/5) = **169,400 Total CFM of outside air for ground floor**

From ASHRAE 2007 Handbook, the minimum total air changes per hour are between 6 and 20 is the max. To simplify and assume worst case scenario, for the calculation I will make all rooms need 20 air changes. The calculations for this are as followed:

(2.032 million ft^3)/(60 min/20) = **677,400 Total CFM for ground floor**

Checking % of outside air for system:

169,400 outside CFM / 667,400 total CFM = **25.4% outside air**

To check typical CFM/sf should be around

[1500 tons x 12,000 btu/ton] / [1.08 x 3(677,400)] = **8.2 degrees (max delta T for cooling)**

Resources & Special Thanks To:

Saint Vincent Health Center

EE Austin's Project Team

Saint Vincent Project Team

Penn State AE Faculty

Dr. David Riley – CM Advisor

APPENDIX G

ICRA Matrix

&

Areas of Risk Drawings

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 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: ____

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Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis MN
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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

Construction Project Type

Patient Risk Group	**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 ____

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Description of Required Infection Control Precautions by Class

	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. Remove isolation of HVAC system in areas where work is being 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. Remove isolation of HVAC system in areas where work is being 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. Remove isolation of HVAC system in areas where work is being performed.

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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),**

____

____

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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 Reviewed 2005

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. Remove or isolate HVAC system in areas where work is being performed.
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. Remove or isolate HVAC system in areas where work is being 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. Remove or isolate HVAC system in areas where work is being 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:

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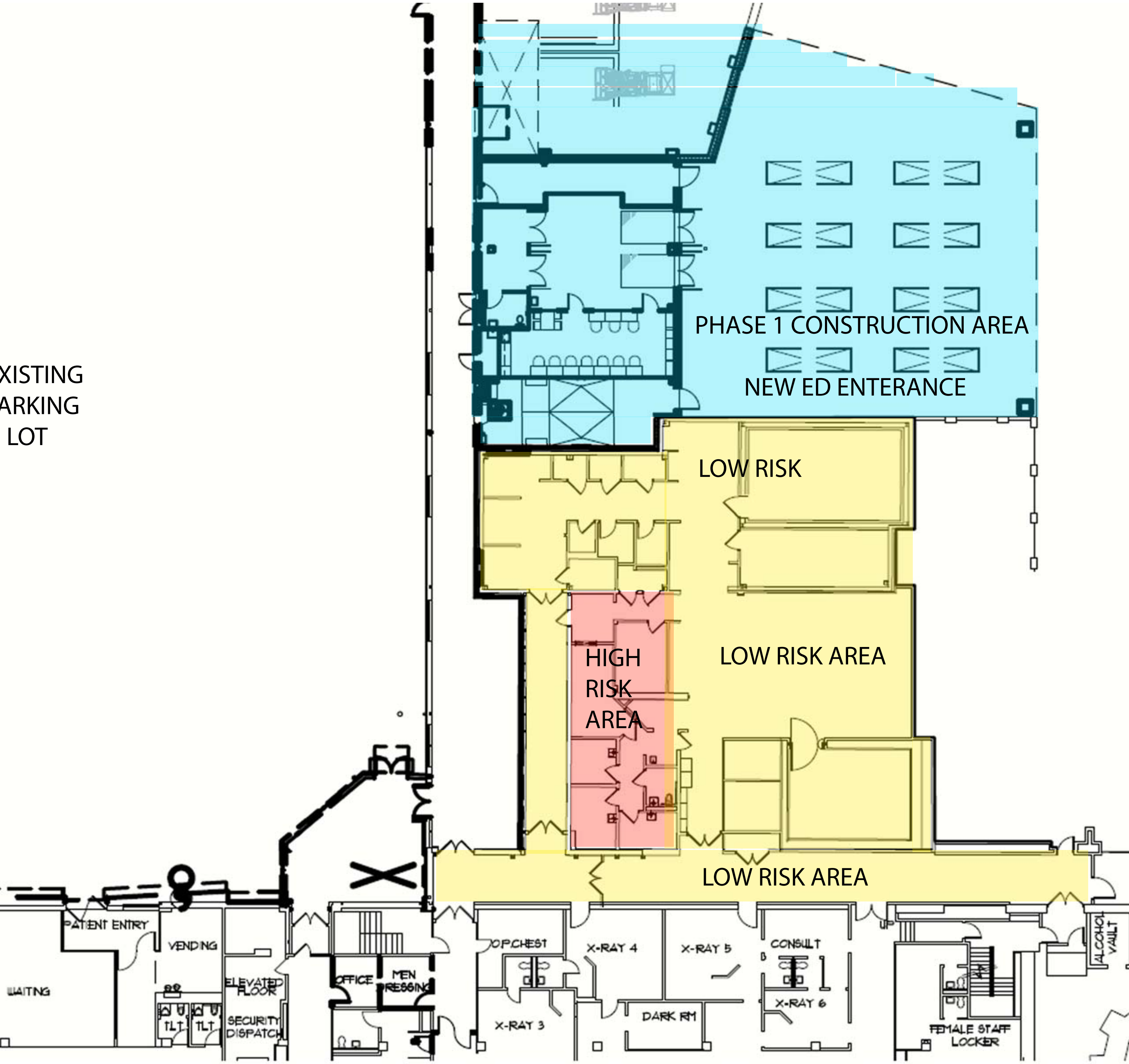
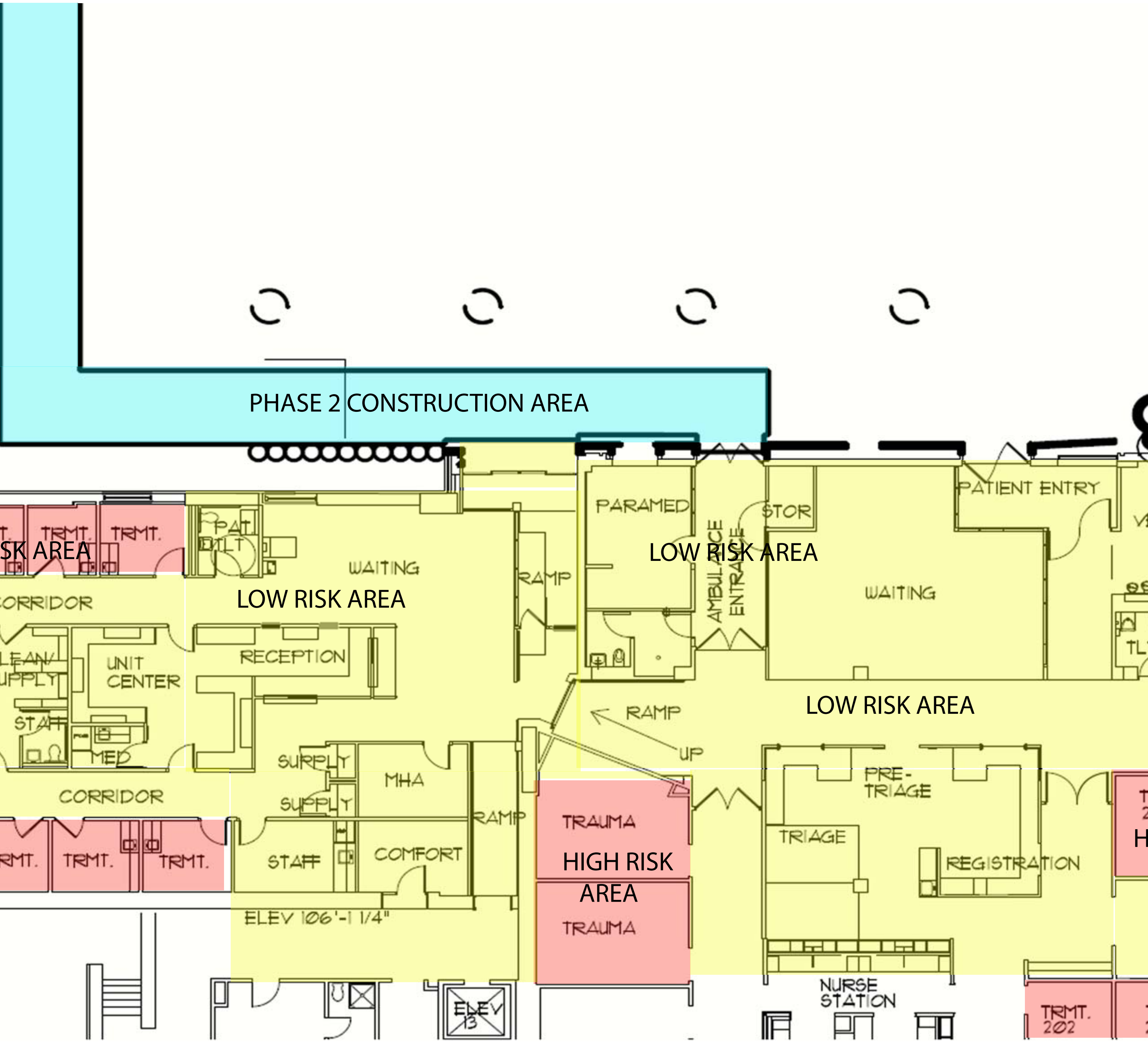
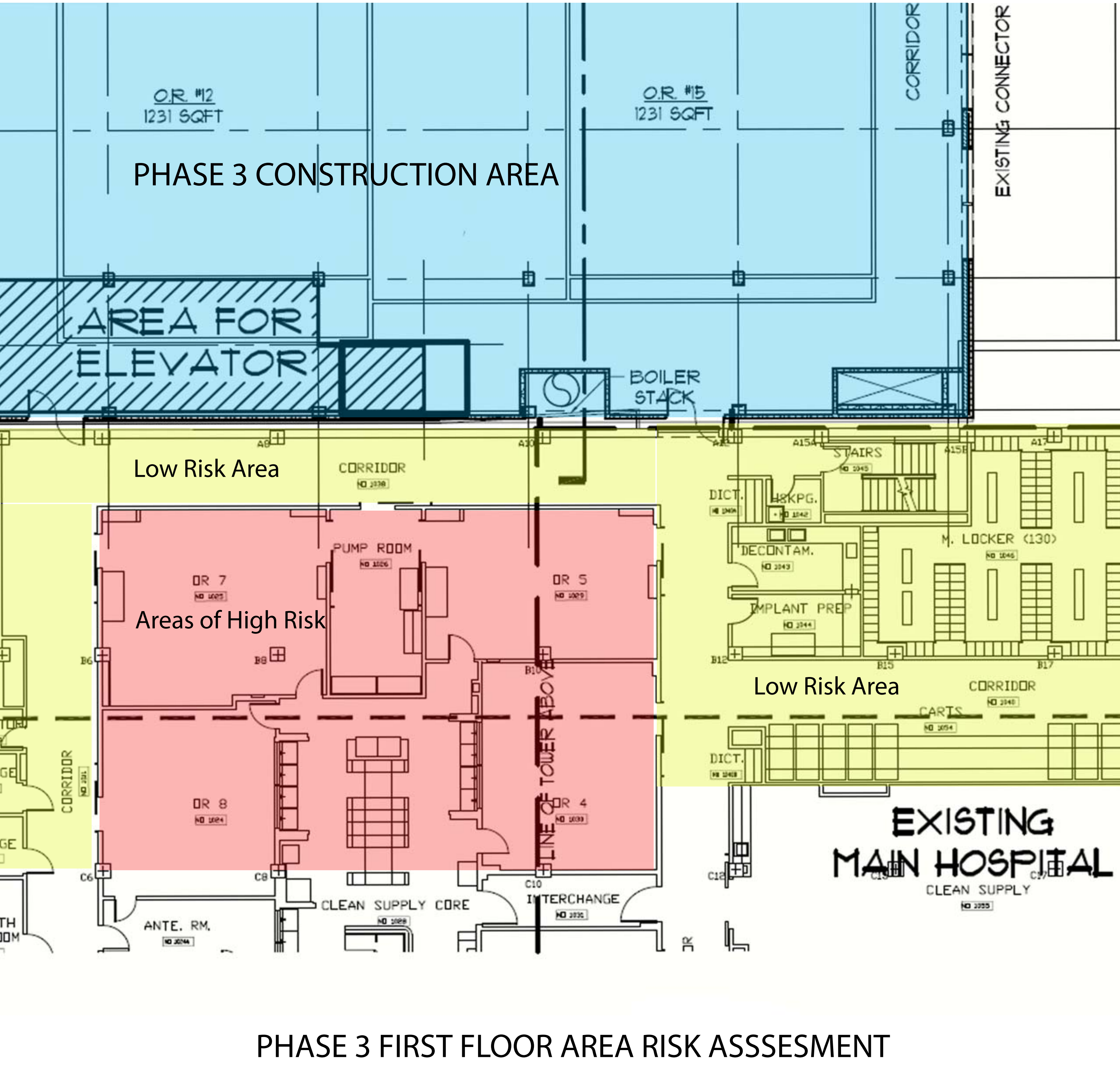


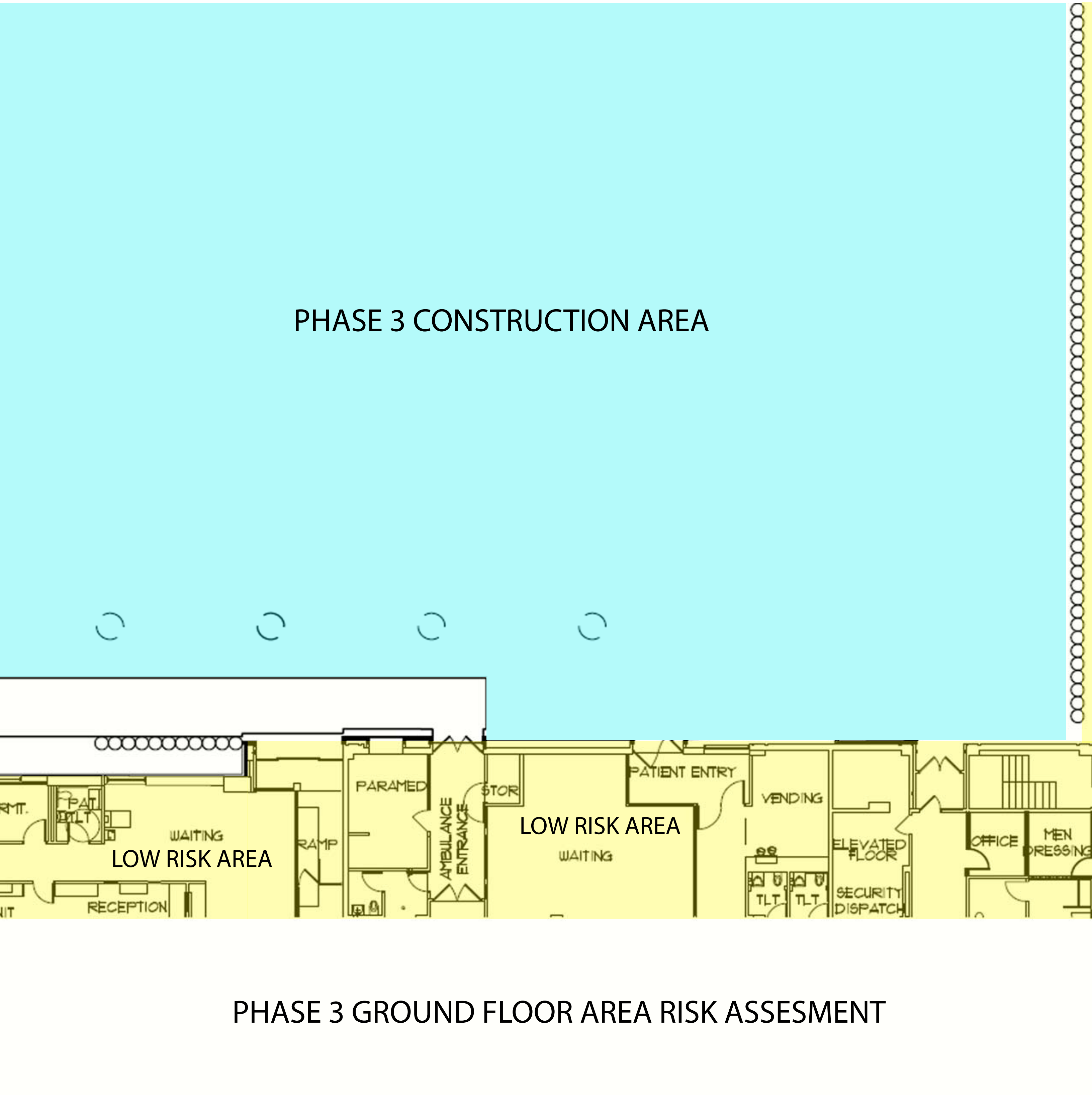
PHASE 1 GROUND FLOOR RISK AREAS



PHASE 2 GROUND FLOOR AREA RISK ASSESMENT



PHASE 3 FIRST FLOOR AREA RISK ASSSESMENT



PHASE 3 GROUND FLOOR AREA RISK ASSESMENT