Joe Bonacci

Technical Assignment 2

Construction

Adv: Rob Leicht

Table of Contents

Executive Summary

The second technical assignment for the analysis of the Charlottesville Community Hospital explores the significant costs and scheduling results of the entire project. The following report represents data for a detailed project schedule, building system detailed and assembly estimates, site layout plans, a general conditions estimate, and a sustainable building design recommendation. The details of these areas of a construction project greatly affect the project's execution and ultimate success.

The project schedule begins on April 25, 2011 and is expected to finish on June 3, 2014. Construction is about 80% completed today, with interior finishes currently being installed. An important milestone of construction was the completion of floors four-six, not including finishes. This achievement would allow for the removal of the material hoist, which would decrease rental fees and make more room on site.

The detailed estimate of the structural system was found to have a total value of $9,692,842.55, which is 58% of the structural system square foot estimate. The assemblies estimate of the mechanical systems was found to have a total value of $9,351,211.29, which is about 45% of the square foot estimate. Lastly, the assemblies estimate for the electrical system was found to have a total value of $2,963,790.11, which is about 20% of the square foot electrical costs. A general conditions estimate was created to show the costs of preliminary items that need to be provided by the general contractor, that do not include actual construction. This particular site utilized many general condition requirements for protection of existing structures. These items include pedestrian side walk protection, existing parking garage column protection, and neighboring restaurant material falling protection. All pricing information for the detailed, assemblies, general condition, and square foot estimates were found in R.S. Means construction cost data.

Site plans for an excavation, superstructure, and a finish phase were created to highlight the important site layout attributes of the entire construction phase. The project team implemented a Sheeting and Shoring system for excavation. Also noted on the site plans are items such as access ways into and out of the site, tower crane location, and loading dock/material hoist locations.

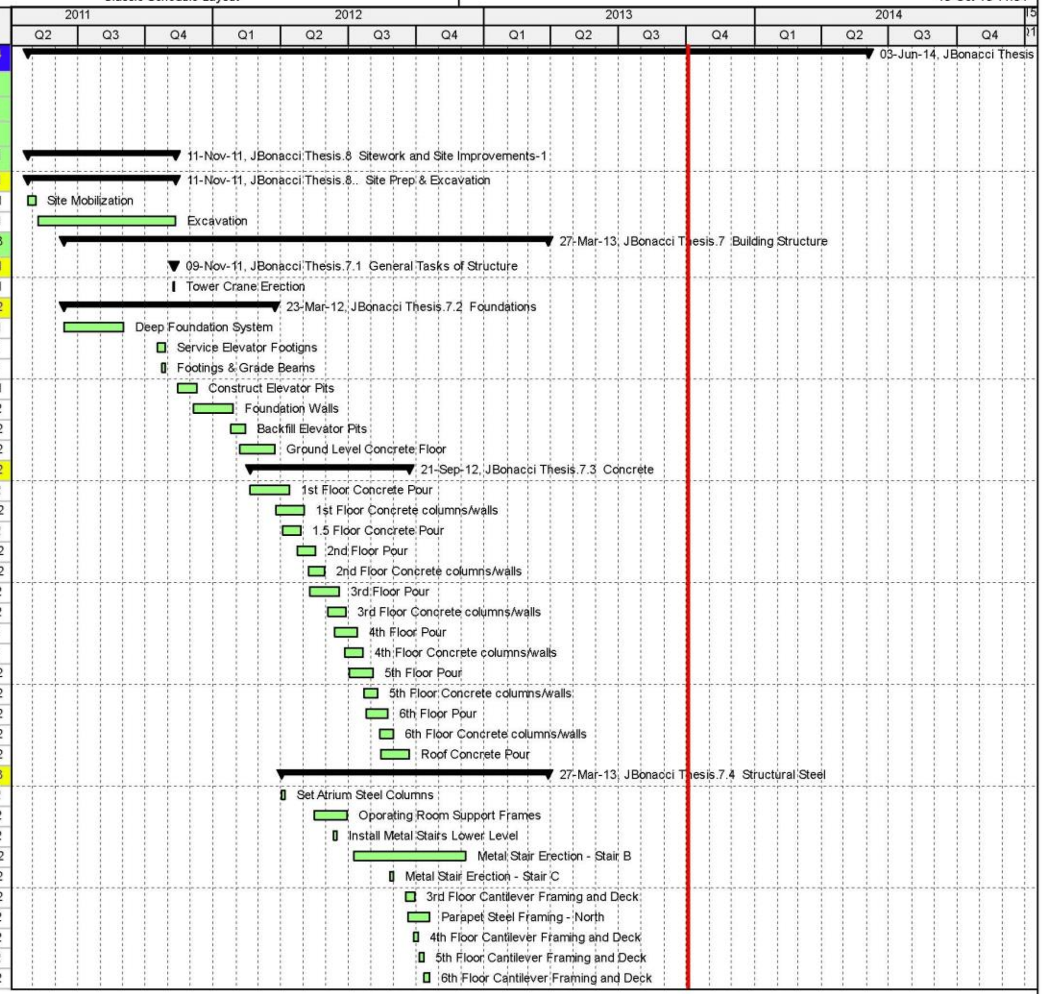
Three constructability concerns found on this project were tight site constraints, feature wall complications, and exam room ceiling height errors. These issues were all resolved by a collaborative effort from the architects, project team, and some subcontractors.

Lastly, a sustainability recommendation was derived by using the LEED rating system for new construction, and the Penn State approach. The hospital is required to receive at least a LEED Silver Certification, which requires a total of 50-59 points. The project team intends to meet this requirement by proposing a total of 51 guaranteed points. The modified sustainability plan has a total of 57 points, which would also receive a LEED Silver Certification. This plan incorporates appropriate green methods for this particular hospital, and greatly considers the impact of the environment and the people of the community.

Detailed Project Schedule

Charlottesville Community Hospital | Classic Schedule Layout | 15-Oct-13 11:34

Activity Name	Original Duration	Start	Finish
JBonacci Thesis Charlottesville Community Hospital	795	25-Apr-11	03-Jun-14
JBonacci Thesis.11 Design-1	0		
JBonacci Thesis.10 Preconstruction-1	0		
JBonacci Thesis.9 Submittals & Material Approvals-1	0		
JBonacci Thesis.8 Sitework and Site Improvements-1	142	25-Apr-11	11-Nov-11
JBonacci Thesis.8.. Site Prep & Excavation	142	25-Apr-11	11-Nov-11
Site Mobilization	10	25-Apr-11	06-May-11
Excavation	132	09-May-'	11-Nov-11
JBonacci Thesis.7 Building Structure	457	13-Jun-11	27-Mar-13
JBonacci Thesis.7.1 General Tasks of Structure	3	07-Nov-11	09-Nov-11
Tower Crane Erection	3	07-Nov-11	09-Nov-11
JBonacci Thesis.7.2 Foundations	200	13-Jun-11	23-Mar-12
Deep Foundation System	59	13-Jun-11	02-Sep-11
Service Elevator Footigns	10	17-Oct-11	28-Oct-11
Footings & Grade Beams	5	24-Oct-11	28-Oct-11
Construct Elevator Pits	19	14-Nov-11	09-Dec-11
Foundation Walls	38	05-Dec-11	27-Jan-12
Backfill Elevator Pits	14	25-Jan-12	13-Feb-12
Ground Level Concrete Floor	35	06-Feb-12	23-Mar-12
JBonacci Thesis.7.3 Concrete	152	20-Feb-12	21-Sep-12
1st Floor Concrete Pour	40	20-Feb-12	13-Apr-12
1st Floor Concrete columns/walls	28	26-Mar-12	02-May-12
1.5 Floor Concrete Pour	19	03-Apr-12	27-Apr-12
2nd Floor Pour	19	24-Apr-12	18-May-12
2nd Floor Concrete columns/walls	15	08-May-'	29-May-12
3rd Floor Pour	27	10-May-'	18-Jun-12
3rd Floor Concrete columns/walls	18	04-Jun-12	27-Jun-12
4th Floor Pour	22	13-Jun-12	13-Jul-12
4th Floor Concrete columns/walls	18	26-Jun-12	20-Jul-12
5th Floor Pour	24	02-Jul-12	03-Aug-12
5th Floor Concrete columns/walls	15	23-Jul-12	10-Aug-12
6th Floor Pour	22	25-Jul-12	23-Aug-12
6th Floor Concrete columns/walls	14	13-Aug-12	30-Aug-12
Roof Concrete Pour	27	15-Aug-12	21-Sep-12
JBonacci Thesis.7.4 Structural Steel	252	02-Apr-12	27-Mar-13
Set Atrium Steel Columns	5	02-Apr-12	06-Apr-12
Oporating Room Support Frames	31	17-May-'	29-Jun-12
Install Metal Stairs Lower Level	5	11-Jun-12	15-Jun-12
Metal Stair Erection - Stair B	108	09-Jul-12	07-Dec-12
Metal Stair Erection - Stair C	5	27-Aug-12	31-Aug-12
3rd Floor Cantilever Framing and Deck	10	17-Sep-12	28-Sep-12
Parapet Steel Framing - North	21	20-Sep-12	18-Oct-12
4th Floor Cantilever Framing and Deck	5	28-Sep-12	04-Oct-12
5th Floor Cantilever Framing and Deck	5	05-Oct-12	11-Oct-12
6th Floor Cantilever Framing and Deck	5	12-Oct-12	18-Oct-12



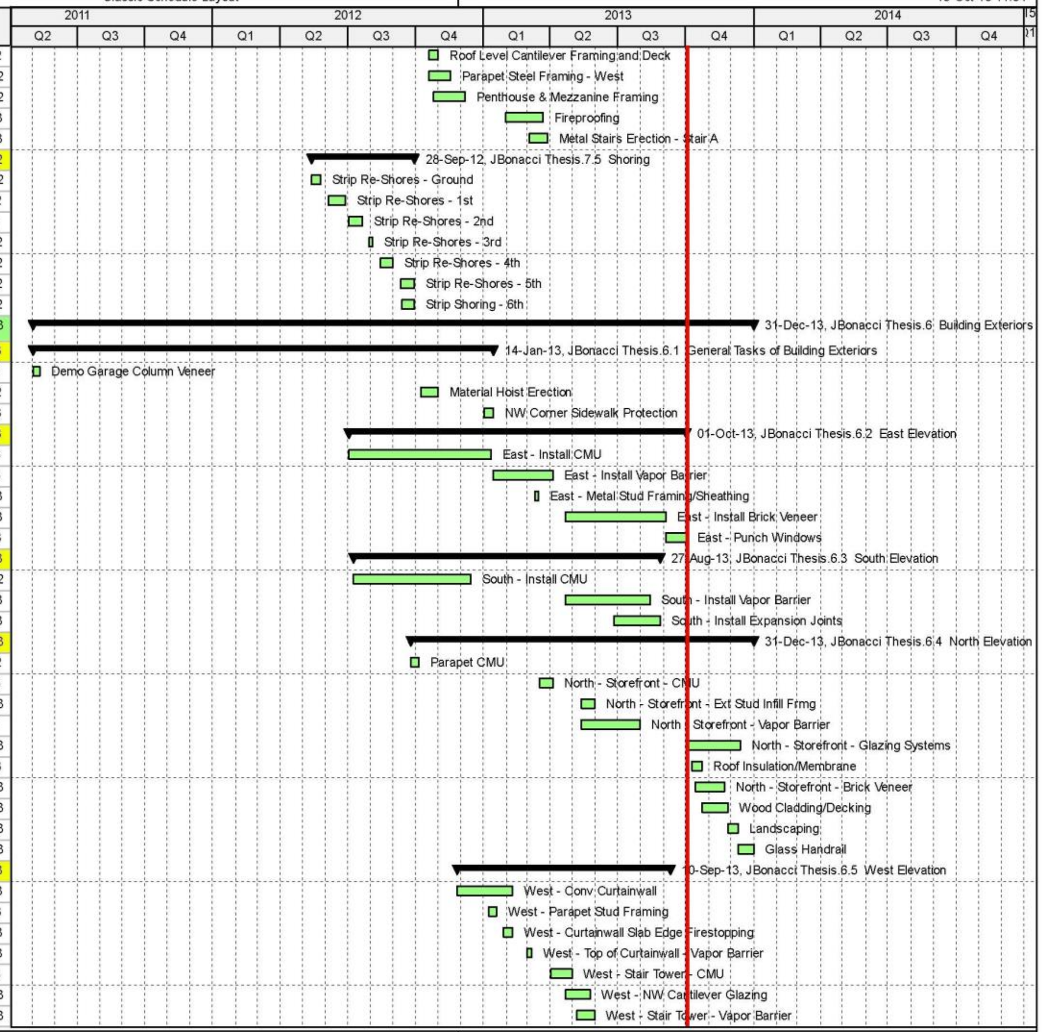
Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

Page 1 of 5

TASK filter: All Activities

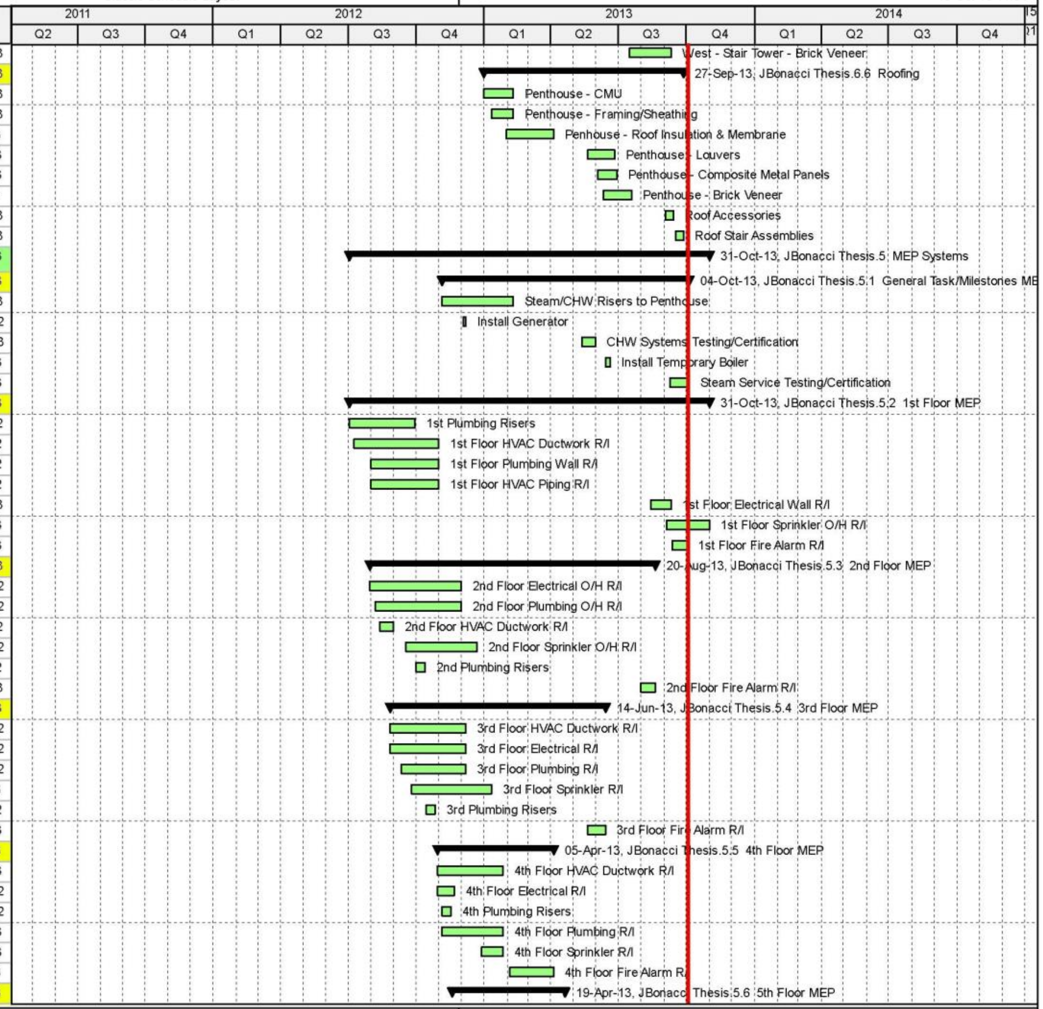
Charlottesville Community Hospital				Classic Schedule Layout	15-Oct-13 11:34

Activity Name	Original Duration	Start	Finish
Roof Level Cantilever Framing and Deck	9	19-Oct-12	31-Oct-12
Parapet Steel Framing - West	21	19-Oct-12	16-Nov-12
Penthouse & Mezzanine Framing	31	25-Oct-12	07-Dec-12
Fireproofing	38	30-Jan-13	22-Mar-13
Metal Stairs Erection - Stair A	18	04-Mar-13	27-Mar-13
JBonacci Thesis.7.5 Shoring	97	14-May-	28-Sep-12
Strip Re-Shores - Ground	10	14-May-	25-May-12
Strip Re-Shores - 1st	17	05-Jun-12	27-Jun-12
Strip Re-Shores - 2nd	14	02-Jul-12	20-Jul-12
Strip Re-Shores - 3rd	5	30-Jul-12	03-Aug-12
Strip Re-Shores - 4th	13	15-Aug-12	31-Aug-12
Strip Re-Shores - 5th	15	10-Sep-12	28-Sep-12
Strip Shoring - 6th	13	12-Sep-12	28-Sep-12
JBonacci Thesis.6 Building Exteriors	680	02-May-	31-Dec-13
JBonacci Thesis.6.1 General Tasks of Building Exteriors	434	02-May-	14-Jan-13
Demo Garage Column Veneer	8	02-May-	11-May-11
Material Hoist Erection	18	08-Oct-12	31-Oct-12
NW Corner Sidewalk Protection	9	02-Jan-13	14-Jan-13
JBonacci Thesis.6.2 East Elevation	319	02-Jul-12	01-Oct-13
East - Install CMU	135	02-Jul-12	11-Jan-13
East - Install Vapor Barrier	60	14-Jan-13	05-Apr-13
East - Metal Stud Framing/Sheathing	5	11-Mar-13	15-Mar-13
East - Install Brick Veneer	94	22-Apr-13	03-Sep-13
East - Punch Windows	20	04-Sep-13	01-Oct-13
JBonacci Thesis.6.3 South Elevation	291	09-Jul-12	27-Aug-13
South - Install CMU	113	09-Jul-12	14-Dec-12
South - Install Vapor Barrier	80	22-Apr-13	13-Aug-13
South - Install Expansion Joints	44	26-Jun-13	27-Aug-13
JBonacci Thesis.6.4 North Elevation	324	24-Sep-12	31-Dec-13
Parapet CMU	10	24-Sep-12	05-Oct-12
North - Storefront - CMU	15	18-Mar-13	05-Apr-13
North - Storefront - Ext Stud Infill Frmg	14	13-May-	31-May-13
North - Storefront - Vapor Barrier	56	13-May-	31-Jul-13
North - Storefront - Glazing Systems	52	02-Oct-13	13-Dec-13
Roof Insulation/Membrane	10	09-Oct-13	22-Oct-13
North - Storefront - Brick Veneer	30	14-Oct-13	22-Nov-13
Wood Cladding/Decking	25	23-Oct-13	26-Nov-13
Landscaping	9	27-Nov-13	10-Dec-13
Glass Handrail	14	11-Dec-13	31-Dec-13
JBonacci Thesis.6.5 West Elevation	202	26-Nov-12	10-Sep-13
West - Conv Curtainwall	53	26-Nov-12	08-Feb-13
West - Parapet Stud Framing	10	07-Jan-13	18-Jan-13
West - Curtainwall Slab Edge Firestopping	10	28-Jan-13	08-Feb-13
West - Top of Curtainwall - Vapor Barrier	6	28-Feb-13	07-Mar-13
West - Stair Tower - CMU	22	01-Apr-13	30-Apr-13
West - NW Cantilever Glazing	25	22-Apr-13	24-May-13
West - Stair Tower - Vapor Barrier	19	06-May-	31-May-13



Actual Level of Effort	Remaining Work	Milestone	Page 2 of 5
Actual Work	Critical Remaining Work	summary	TASK filter: All Activities

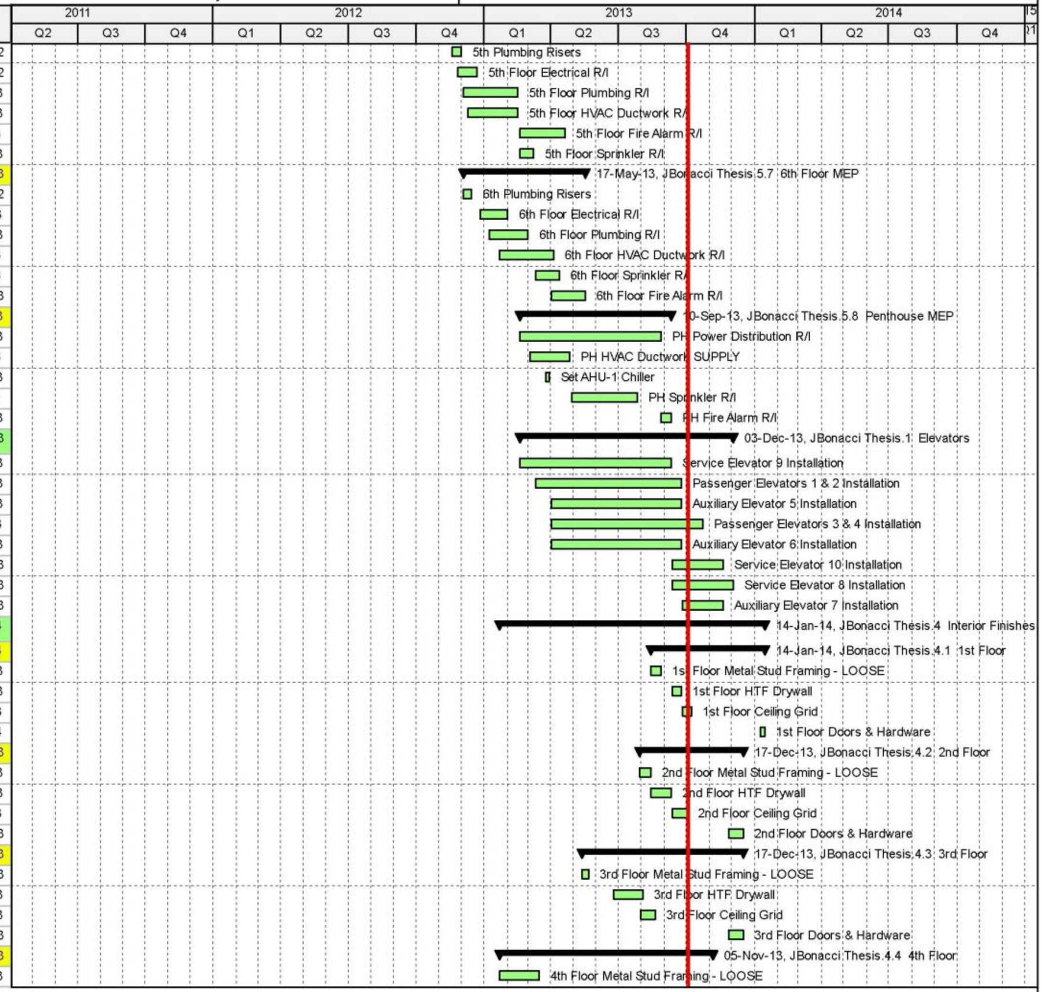
Charlottesville Community Hospital				Classic Schedule Layout	15-Oct-13 11:34
Activity Name	Original Duration	Start	Finish		
West - Stair Tower - Brick Veneer	41	15-Jul-13	10-Sep-13		
JBonacci Thesis.6.6 Roofing	191	31-Dec-12	27-Sep-13		
Penthouse - CMU	29	31-Dec-12	08-Feb-13		
Penthouse - Framing/Sheathing	21	11-Jan-13	08-Feb-13		
Penhouse - Roof Insulation & Membrane	47	31-Jan-13	05-Apr-13		
Penthouse - Louvers	26	20-May-`	25-Jun-13		
Penthouse - Composite Metal Panels	20	03-Jun-13	28-Jun-13		
Penthouse - Brick Veneer	29	10-Jun-13	19-Jul-13		
Roof Accessories	9	03-Sep-13	13-Sep-13		
Roof Stair Assemblies	10	16-Sep-13	27-Sep-13		
JBonacci Thesis.5 MEP Systems	341	02-Jul-12	31-Oct-13		
JBonacci Thesis.5.1 General Task/Milestones MEP	234	05-Nov-12	04-Oct-13		
Steam/CHW Risers to Penthouse	67	05-Nov-12	08-Feb-13		
Install Generator	4	04-Dec-12	07-Dec-12		
CHW Systems Testing/Certification	14	13-May-`	31-May-13		
Install Temporary Boiler	4	14-Jun-13	19-Jun-13		
Steam Service Testing/Certification	20	09-Sep-13	04-Oct-13		
JBonacci Thesis.5.2 1st Floor MEP	341	02-Jul-12	31-Oct-13		
1st Plumbing Risers	63	02-Jul-12	28-Sep-12		
1st Floor HVAC Ductwork R/I	82	09-Jul-12	31-Oct-12		
1st Floor Plumbing Wall R/I	65	01-Aug-12	31-Oct-12		
1st Floor HVAC Piping R/I	65	01-Aug-12	31-Oct-12		
1st Floor Electrical Wall R/I	19	14-Aug-13	10-Sep-13		
1st Floor Sprinkler O/H R/I	42	04-Sep-13	31-Oct-13		
1st Floor Fire Alarm R/I	15	11-Sep-13	01-Oct-13		
JBonacci Thesis.5.3 2nd Floor MEP	271	30-Jul-12	20-Aug-13		
2nd Floor Electrical O/H R/I	88	30-Jul-12	30-Nov-12		
2nd Floor Plumbing O/H R/I	83	06-Aug-12	30-Nov-12		
2nd Floor HVAC Ductwork R/I	14	13-Aug-12	30-Aug-12		
2nd Floor Sprinkler O/H R/I	69	17-Sep-12	21-Dec-12		
2nd Plumbing Risers	10	01-Oct-12	12-Oct-12		
2nd Floor Fire Alarm R/I	15	31-Jul-13	20-Aug-13		
JBonacci Thesis.5.4 3rd Floor MEP	205	27-Aug-12	14-Jun-13		
3rd Floor HVAC Ductwork R/I	73	27-Aug-12	07-Dec-12		
3rd Floor Electrical R/I	73	27-Aug-12	07-Dec-12		
3rd Floor Plumbing R/I	64	10-Sep-12	07-Dec-12		
3rd Floor Sprinkler R/I	77	24-Sep-12	11-Jan-13		
3rd Plumbing Risers	10	15-Oct-12	26-Oct-12		
3rd Floor Fire Alarm R/I	19	20-May-`	14-Jun-13		
JBonacci Thesis.5.5 4th Floor MEP	112	29-Oct-12	05-Apr-13		
4th Floor HVAC Ductwork R/I	62	29-Oct-12	25-Jan-13		
4th Floor Electrical R/I	18	29-Oct-12	21-Nov-12		
4th Plumbing Risers	10	05-Nov-12	16-Nov-12		
4th Floor Plumbing R/I	57	05-Nov-12	25-Jan-13		
4th Floor Sprinkler R/I	20	28-Dec-12	25-Jan-13		
4th Floor Fire Alarm R/I	45	04-Feb-13	05-Apr-13		
JBonacci Thesis.5.6 5th Floor MEP	107	19-Nov-12	19-Apr-13		



Actual Level of Effort	Remaining Work	Milestone	Page 3 of 5	TASK filter: All Activities	
Actual Work	Critical Remaining Work	summary			© Oracle Corporation

Charlottesville Community Hospital | Classic Schedule Layout | 15-Oct-13 11:34

Activity Name	Original Duration	Start	Finish
5th Plumbing Risers	9	19-Nov-12	30-Nov-12
5th Floor Electrical R/I	20	26-Nov-12	21-Dec-12
5th Floor Plumbing R/I	53	03-Dec-12	15-Feb-13
5th Floor HVAC Ductwork R/I	48	10-Dec-12	15-Feb-13
5th Floor Fire Alarm R/I	45	18-Feb-13	19-Apr-13
5th Floor Sprinkler R/I	15	18-Feb-13	08-Mar-13
JBonacci Thesis.5.7 6th Floor MEP	118	03-Dec-12	17-May-13
6th Plumbing Risers	10	03-Dec-12	14-Dec-12
6th Floor Electrical R/I	26	26-Dec-12	31-Jan-13
6th Floor Plumbing R/I	39	07-Jan-13	28-Feb-13
6th Floor HVAC Ductwork R/I	55	21-Jan-13	05-Apr-13
6th Floor Sprinkler R/I	25	11-Mar-13	12-Apr-13
6th Floor Fire Alarm R/I	35	01-Apr-13	17-May-13
JBonacci Thesis.5.8 Penthouse MEP	144	18-Feb-13	10-Sep-13
PH Power Distribution R/I	135	18-Feb-13	27-Aug-13
PH HVAC Ductwork SUPPLY	40	04-Mar-13	26-Apr-13
Set AHU-1 Chiller	5	25-Mar-13	29-Mar-13
PH Sprinkler R/I	63	29-Apr-13	26-Jul-13
PH Fire Alarm R/I	9	28-Aug-13	10-Sep-13
JBonacci Thesis.1 Elevators	203	18-Feb-13	03-Dec-13
Service Elevator 9 Installation	144	18-Feb-13	10-Sep-13
Passenger Elevators 1 & 2 Installation	139	11-Mar-13	24-Sep-13
Auxiliary Elevator 5 Installation	124	01-Apr-13	24-Sep-13
Passenger Elevators 3 & 4 Installation	144	01-Apr-13	22-Oct-13
Auxiliary Elevator 6 Installation	124	01-Apr-13	24-Sep-13
Service Elevator 10 Installation	50	11-Sep-13	19-Nov-13
Service Elevator 8 Installation	59	11-Sep-13	03-Dec-13
Auxiliary Elevator 7 Installation	40	25-Sep-13	19-Nov-13
JBonacci Thesis.4 Interior Finishes	252	21-Jan-13	14-Jan-14
JBonacci Thesis.4.1 1st Floor	107	14-Aug-13	14-Jan-14
1st Floor Metal Stud Framing - LOOSE	10	14-Aug-13	27-Aug-13
1st Floor HTF Drywall	10	11-Sep-13	24-Sep-13
1st Floor Ceiling Grid	10	25-Sep-13	08-Oct-13
1st Floor Doors & Hardware	5	08-Jan-14	14-Jan-14
JBonacci Thesis.4.2 2nd Floor	100	29-Jul-13	17-Dec-13
2nd Floor Metal Stud Framing - LOOSE	12	29-Jul-13	13-Aug-13
2nd Floor HTF Drywall	19	14-Aug-13	10-Sep-13
2nd Floor Ceiling Grid	15	11-Sep-13	01-Oct-13
2nd Floor Doors & Hardware	14	27-Nov-13	17-Dec-13
JBonacci Thesis.4.3 3rd Floor	153	13-May-	17-Dec-13
3rd Floor Metal Stud Framing - LOOSE	8	13-May-	22-May-13
3rd Floor HTF Drywall	29	24-Jun-13	02-Aug-13
3rd Floor Ceiling Grid	15	31-Jul-13	20-Aug-13
3rd Floor Doors & Hardware	14	27-Nov-13	17-Dec-13
JBonacci Thesis.4.4 4th Floor	204	21-Jan-13	05-Nov-13
4th Floor Metal Stud Framing - LOOSE	40	21-Jan-13	15-Mar-13

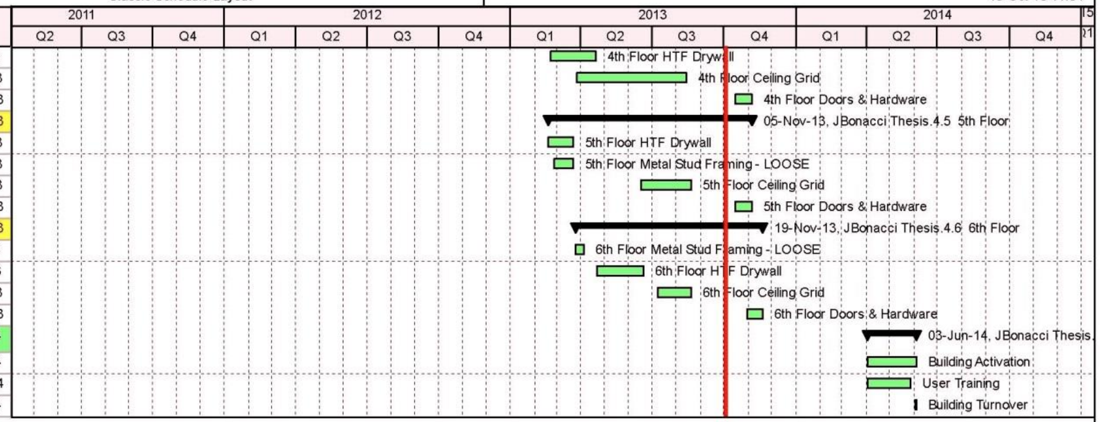


Actual Level of Effort | Remaining Work | ◆ Milestone
Actual Work | Critical Remaining Work | summary

TASK filter: All Activities

Charlottesville Community Hospital | Classic Schedule Layout | 15-Oct-13 11:34

Activity Name	Original Duration	Start	Finish
4th Floor HTF Drywall	42	21-Feb-13	19-Apr-13
4th Floor Ceiling Grid	99	26-Mar-13	13-Aug-13
4th Floor Doors & Hardware	15	16-Oct-13	05-Nov-13
JBonacci Thesis.4.5 5th Floor	184	18-Feb-13	05-Nov-13
5th Floor HTF Drywall	25	18-Feb-13	22-Mar-13
5th Floor Metal Stud Framing - LOOSE	20	25-Feb-13	22-Mar-13
5th Floor Ceiling Grid	46	17-Jun-13	20-Aug-13
5th Floor Doors & Hardware	15	16-Oct-13	05-Nov-13
JBonacci Thesis.4.6 6th Floor	169	25-Mar-13	19-Nov-13
6th Floor Metal Stud Framing - LOOSE	10	25-Mar-13	05-Apr-13
6th Floor HTF Drywall	43	22-Apr-13	20-Jun-13
6th Floor Ceiling Grid	32	08-Jul-13	20-Aug-13
6th Floor Doors & Hardware	15	30-Oct-13	19-Nov-13
JBonacci Thesis.3 Project Completion/Closeout	45	02-Apr-14	03-Jun-14
Building Activation	45	02-Apr-14	03-Jun-14
User Training	40	02-Apr-14	27-May-14
Building Turnover	1	03-Jun-14	03-Jun-14



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

Page 5 of 5

TASK filter: All Activities

Schedule Summary

The schedule represents the major general items of construction from design to turnover. The vertical red line represents the status of the project today. It is noticeable that MEP for each floor is still under construction, which means that work is done on each floor simultaneously. This method is also evident in the building elevations, all of which are still under construction. Interior finishes and furnishings and two of the most important items on the schedule because these two subjects are closely observed by owner inspectors. After MEP installation was completed, construction began from the fourth floor and worked its way to the top. The last floors to be completed are the third, second, first, and ground respectively. The reason for this order has to do with site limitations of the building's material hoist. The goal is to complete all major work on the top three floors so that the material hoist can be disassembled and taken off site. The lower three floors will then be able to receive material via forklift from the ground level.

Detailed Structural Systems Estimate

CONCRETE							
Assembly	**CY**	**Material**	**Labor**	**Equipment**	**Total cost**		
Foundation Walls	350.4	$450.00	$490.00	$30.00	$339,888.00		
Caissons	1740	$705.00	$395.00	$33.00	$1,971,420.00		
Caisson Caps	29.3	$154.00	$64.00	$0.43	$6,400.00		
Grade Beams	347	$330.00	$485.00	$40.50	$296,858.50		
Slab on Grade	373	$116.00	$53.00	$0.45	$63,204.85		
					$2,677,771.35		
Extrapolated Costs						**# of Floors**	**Total Cost**
Floor Slabs	373	$237.00	$330.00	$26.50	$221,375.50	8	$1,771,004.00
Columns	69.8	$430.00	$510.00	$42.00	$68,543.60	7	$479,805.20
Beams	569	$330.00	$485.00	$40.50	$464,344.50	7	$3,250,411.50
							$5,501,220.70

Total Concrete Cost: $8,178,992.05

STEEL REINFORCING						
Assembly	**Tonnage**	**Material**	**Labor**	**Total cost**		
Foundation Walls	42.6	$1,000.00	$530.00	$65,178.00		
Caissons	118.4	$1,000.00	$695.00	$200,688.00		
Caisson Caps	3.5	$1,000.00	$695.00	$5,932.50		
Grade Beams	9.8	$1,000.00	$995.00	$19,551.00		
Slab on Grade	65.8	$1,000.00	$695.00	$111,531.00		
				$402,880.50		
Extrapolated Costs					**# of Floors**	**Total Cost**
Floor Slabs	65.8	$1,000.00	$550.00	$101,990.00	8	$815,920.00
Columns	5.8	$1,000.00	$695.00	$9,831.00	7	$68,817.00
Beams	16.2	$1,000.00	$995.00	$32,319.00	7	$226,233.00
						$1,110,970.00

Total Steel Reinforcing Cost: $1,513,850.50

Structural System Detailed Estimate Total

$9,692,842.55

Detailed Structural Systems Estimate

The new hospital is composed predominantly of a concrete structure with steel reinforcing. To find an estimate of the materials used in the building, a detailed estimate of the fourth floor was completed. Each concrete beam listed in figures 1-4 in the appendix is located on the fourth floor. This floor was chosen for analysis because it most closely represents the other floors, and contains the most amount components.

The installed Caissons have diameters that range anywhere from four-six feet. An average of five feet was assumed for the calculations of concrete and steel reinforcing. A similar variance exists in the size of the caisson caps, so an average of nine cubic feet was assumed. The Concrete Columns of the Structure are comprised of both square and cylindrical shaped columns. The total height of each column is 14 feet, which is represented as 168 inches in figure 5 of the appendix.

Bar sizes used for concrete construction include bars #'s 4-11 for steel reinforcing. The most common type, #4, has a smaller diameter and a better workability. It is used in all columns and caissons as a longitudinal reinforcement that wraps around the particular element, usually placed every 10"-12" up the height of the concreter structure. Reinforcing in both the slab on grade and on each floor is also made of #4 bar. They are placed every 12" apart in both directions, one placed on top of the other.

The total detailed structural estimate was found to be about 58% of the square foot estimate calculated for this system. A number of minor items included in construction were omitted from the detailed estimate. Many of these items include small structural steel beams that cantilever over the Northwest corner of the building on floors two-six. Also the stair systems on the building were not taken into account.

MECHANICAL SYSTEM							
	AHU's	**CFM**	**Material Cost/sf**	**Install cost/sf**	**Total cost/sf**	**SF**	**Total Cost**
	1	30,000	$9.05	$8.20	$17.25	30,151	$1,040,209.50
	2	73,000	$9.05	$8.20	$17.25	73,367	$2,531,161.50
	3	96,000	$9.05	$8.20	$17.25	96,482	$3,328,629.00
							$6,900,000.00
		Qty	**Material Cost**	**Install cost**	**Total Cost**		
VAV'S		253	$2,998.38	$5,312.50	$2,102,652.64		
Boiler		1	$39,937.60	$13,815.00	$53,752.60		
Chill Water Pumps		2	$1,994.40	$334.87	$4,658.54		
Hot Water Pumps		3	$45,538.80	$5,289.55	$152,485.05		
Fan Coil A		1	$1,778.20	$96.91	$1,875.11		
Fan Coil B		1	$2,118.15	$101.32	$2,219.47		
Fan Coil C		1	$3,399.50	$183.25	$3,582.75		
Fan Coil D		1	$2,458.10	$133.03	$2,591.13		
Fan Coil E		1	$2,458.10	$133.03	$2,591.13		
Fan Coil F		1	$3,138.00	$155.94	$3,293.94		
Expansion Tank		1	$1,035.98	$67.35	$1,103.33		
Heat Exchangers		2	$57,616.00	$2,586.80	$120,405.60		
					$2,451,211.29		

Mechanical System Assemblies Estimate Total

$9,351,211.29

The major highlights of the hospital's mechanical system include large air handling units and an extensive VAV system throughout the building. To price the components, values were extracted from R.S. Means Assemblies cost data and interpolated if necessary to correlate to the size of the equipment found in the building. The cost data chosen for the AHU's reflects that of an office building because hospital values were not listed. Another assumption made was the CFM rate of the VAV boxes. The values range from 400 to 2200 CFM, so an average value of 1000 CFM was chosen for pricing calculations.

The three hot water heat pumps in the building use a rate of 275 gallons per minute. Pumps one and two are primary pumps, and the third is a spare. The closest rate available for pricing used was a 255 GPM pump. A modified value for the size of the boiler was also adjusted to match R.S. Means values. A 962 KW, 3283 MBH boiler was used in calculation. The total detailed mechanical system estimate came out to be about 45% of what was calculated from the square foot estimate for this system. The complexity of the building systems of new hospitals and the higher scale equipment and furnishings used in this particular building have much to do with the price difference.

ELECTRICAL SYSTEM				
	Qty	Material Cost	Install cost	Total Cost
Main Switch Board	2	$82,000.00	$12,000.00	$188,000.00
Switch Board	1	$16,500.00	$3,825.00	$20,325.00
Switch Board	1	$17,500.00	$4,325.00	$21,825.00
Emergency Switch Board	1	$60,000.00	$11,000.00	$71,000.00
Emergency Generator	1	$202,572.00	$7,928.00	$210,500.00
Distribution Panels (600A)	3	$16,200.00	$11,200.00	$82,200.00
Distribution Panels (400A)	1	$8,500.00	$7,600.00	$16,100.00
Distribution Panels (800A)	2	$22,000.00	$15,000.00	$74,000.00
Transformers (15KVA)	7	$3,549.98	$767.00	$30,218.86
Transformers (30KVA)	7	$3,972.00	$1,060.50	$35,227.50
Transformers (45KVA)	8	$5,411.85	$1,212.00	$52,990.80
Transformers (75KVA)	1	$7,894.35	$1,313.00	$9,207.35
Transformers (112.5KVA)	4	$10,724.40	$1,237.25	$47,846.60
Transformers (2500KVA)	2	$89,370.00	$5,252.00	$189,244.00
Panelboards (150A)	56	$6,175.00	$4,800.00	$614,600.00
Panelboards (100A)	19	$3,050.00	$3,800.00	$130,150.00
Panelboards (60A)	8	$2,520.00	$2,990.00	$44,080.00
Panelboards (400A)	4	$12,000.00	$11,500.00	$94,000.00
Panelboards (600A)	1	$23,000.00	$15,500.00	$38,500.00
Panelboards (225A)	1	$7,250.00	$6,000.00	$13,250.00
Panelboards (250A)	1	$9,100.00	$7,175.00	$16,275.00
				$1,999,540.11

	Qty	Material	Instalation	L.F.	Total
Feeders (400 Amps)	95	$56.00	$45.50	100	$964,250.00

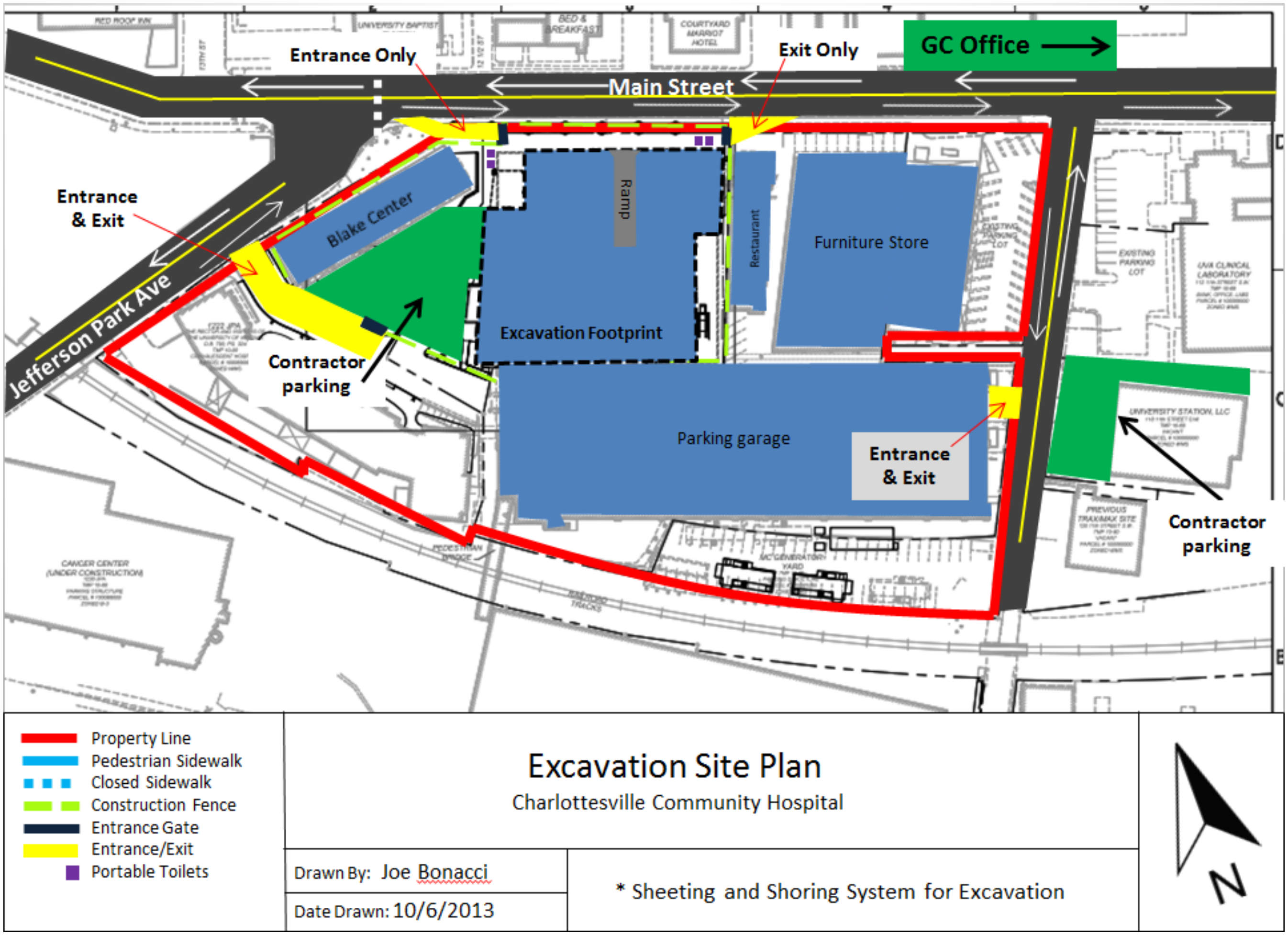
Electrical System Assemblies Estimate Total

$2,963,790.11

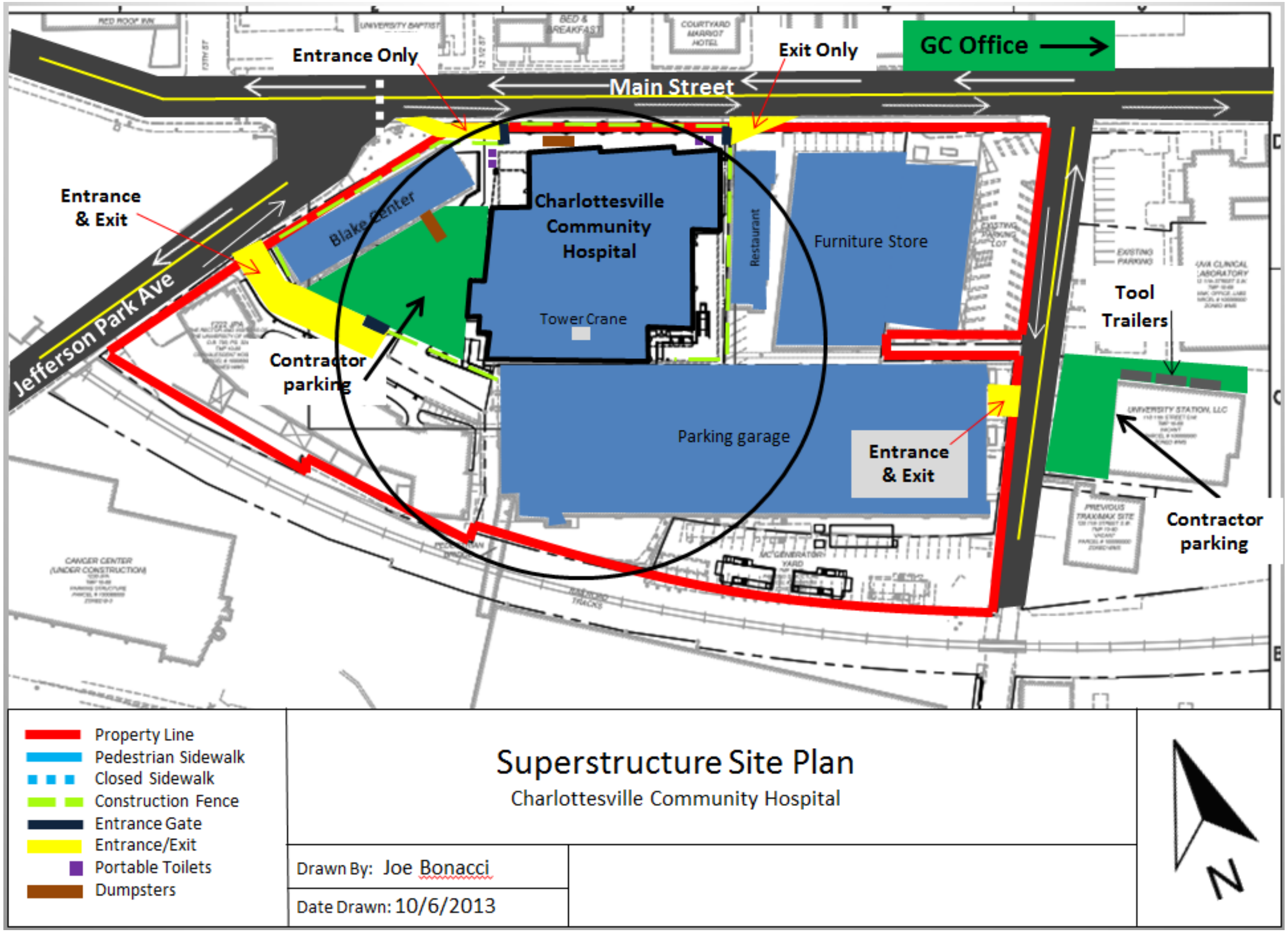
The electrical system of the building includes two main switch boards and 29 individual transformers. Of the 29 transformers, nine are located on the normal branch, eight are located on a critical branch, seven are located on life-safety branch, and 5 are located on an equipment branch. The main switch boards have a capacity of 4000 amps, and were prices accordingly also using R.S. Means Assemblies cost data.

The total electrical system estimate was found to be about 20% of what was calculated from the square foot estimate for this system. Items omitted from the assemblies estimate throughout the building include copper wiring and light fixtures.

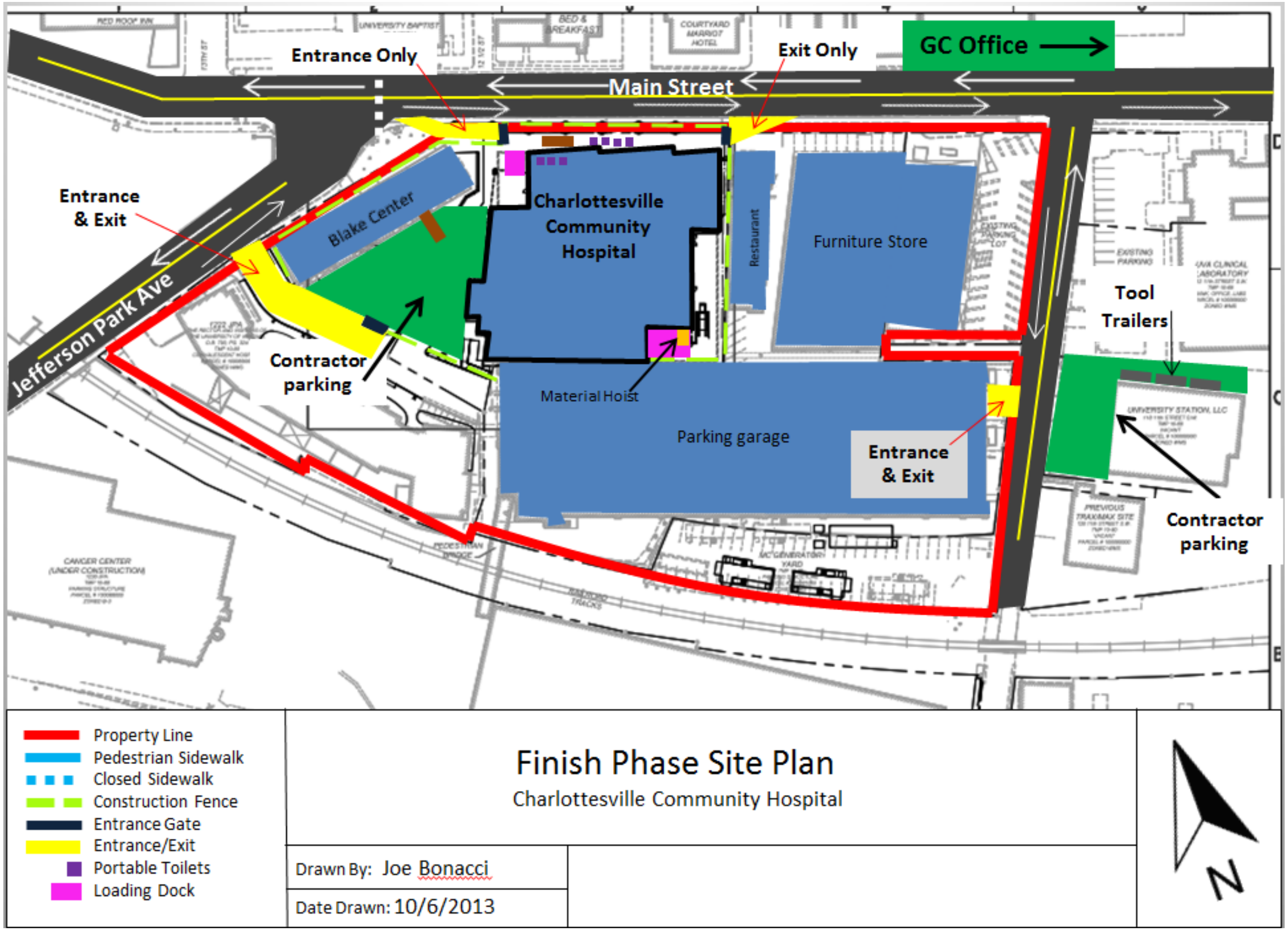
Site Layout Planning



The above site plan represents the site during the excavation portion of the project. Notable features include site entrances and exits, contractor parking, and the access ramp to the bottom pit of the building foot print. There are four locations into and out of the site. The two southernmost, represented in yellow, have two lanes for access into and out of the project. These locations are predominantly for material deliveries. They are effective in this manner because they are connected to side streets that see limited traffic compared to Main Street on the buildings North face. These processes work efficiently, with entrance and exit only access ways located on the more narrow and congested side of the project. An earth access ramp seen above provides access for excavation and foundation equipment. A regular Sheeting and Shoring method is used for temporary support of excavation.



During the base building construction phase of the project, a tower crane is erected which serves as the primary source for material hoists. It is located within the perimeter of the building, on the Southern edge as seen above. A small amount of tool and equipment staging is now set up near part of the contractor parking areas, as more trades will be introduced at this stage of construction. Two dumpsters are brought on site and will be used for the remainder of construction. They are located in easily accessible area so that they can be easily transported to and from the site.



The finish phase site plan introduces the use of loading docks, seen in pink, and a material hoist, seen in orange. These features provide almost all access of interior building materials. The primary function of the loading dock on the northern corner of the building is for trash removal. It is located near a trash dumpster and is regularly manned by at least one member of the GC's construction team. The loading dock in the southern corner receives most deliveries, and surrounds the material hoist. All major deliveries use this hoist and loading dock by entering through the east entrance to the parking garage, and traveling through the garage to the material hoist. Portable toilets are located on the ground level along Main Street, as well on the third floor mezzanine roof. These portable toilets on the roof are on an exposed platform that will eventually be the location of a green roof, and it is accessible by a temporary door way from the third floor. This prevents the need for crew members to have to travel from the top floors of the project all the way to the ground floor, which wastes time and causes more foot traffic on site.

General Conditions Estimate

General Conditions Estimate							
	QTY	UNIT	MAT.$/UNIT	MAT. TOTAL	LABOR $/UNIT	LABOR TOTAL	GRAND TOTAL
Utilities							
Temporary Electricity	286	CSF/Flr	$2.80	$800.80	$12.35	$3,532.10	$4,332.90
Temporary Heat	3	MO	$1,500.00	$4,500.00		$0.00	$4,500.00
Temporary Water	36	MO	$80.00	$2,880.00		$0.00	$2,880.00
Temporary Structures							
Job Office	180	MO	$500.00	$90,000.00		$0.00	$90,000.00
Protective Walkway	560	SF	$0.95	$532.00	$1.51	$845.60	$1,377.60
Fencing	850	LF	$3.59	$3,051.50	$9.35	$7,947.50	$10,999.00
Temporary Services							
Portable Toilets	6	MO	$800.00	$4,800.00		$0.00	$4,800.00
Drinking Water	48	MO	$225.00	$10,800.00		$0.00	$10,800.00
Dumpsters	208	EA	$70.00	$14,560.00		$0.00	$14,560.00
Radios/Phones	14	EA	$100.00	$1,400.00		$0.00	$1,400.00
Field Personnel							
Field Engineer (2)	312	weeks			$1,325.00	$413,400.00	$413,400.00
General Labor (2)	312	weeks			$1,425.00	$444,600.00	$444,600.00
General Superintendent (1)	156	weeks			$2,300.00	$358,800.00	$358,800.00
Sr. Project Manager (1)	208	weeks			$2,475.00	$514,800.00	$514,800.00
Project Manager (4)	624	weeks			$2,150.00	$1,341,600.00	$1,341,600.00
Assistant Project Manager (2)	208	weeks			$1,875.00	$390,000.00	$390,000.00
Superintendent (2)	312	weeks			$2,000.00	$624,000.00	$624,000.00
Equipment							
Material Hoist	2	LS	$10,000.00	$20,000.00			$20,000.00
Forklift	156	weeks	$250.00	$39,000.00	$1,825.00	$284,700.00	$323,700.00
Tower Crane	8	MO	$23,600.00	$188,800.00	$8,600.00	$68,800.00	$257,600.00
Bobcat	156	weeks	$150.00	$23,400.00	$1,825.00	$284,700.00	$308,100.00
Miscellaneous							
Garage Column Protection	144	SF	$0.95	$136.80	$1.51	$217.44	$354.24
Fire Extinguishers	14	EA	$275.00	$3,850.00		$0.00	$3,850.00
Baricades	200	LF	$5.35	$1,070.00	$36.00	$7,200.00	$8,270.00
First Aid	1	LS	$2,000.00	$2,000.00		$0.00	$2,000.00
Clean Up During Construction	200	M.S.F	$1.83	$366.00	$18.21	$3,642.00	$4,008.00
						Total	$5,160,731.74

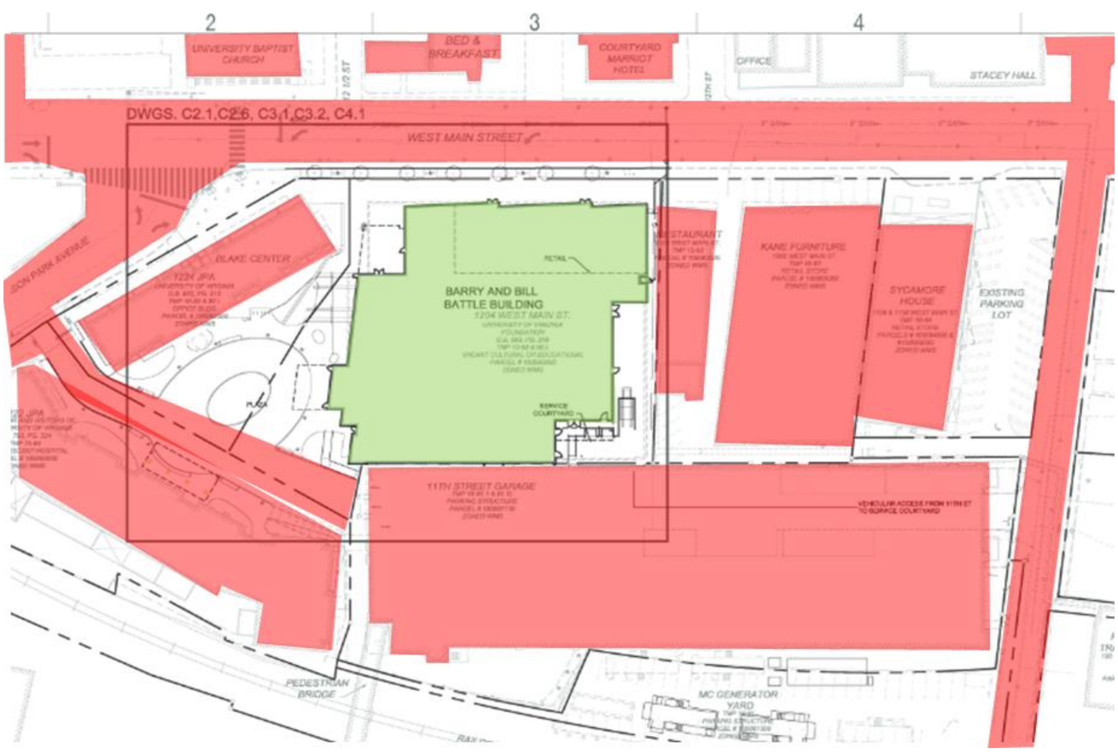
Items not included in this general conditions estimate include insurance, GC mark-up, and bonds. Some quantities for items were assumed such as first aid costs, Radio/Phones quantity and cost, and the amount of weeks needed for the forklift and bobcat. The dumpster quantity was calculated by multiplying two dumpsters by the amount of 104 weeks, assuming each dumpster is replaced once a week for a duration of two years. Besides assumed costs, all costs were found in RS Means.

Constructability Challenges

Site Constraints

The Charlottesville Community Hospital is centrally located on a busy part of Main Street with existing buildings on three sides of the project. Heavy foot and vehicle traffic adds to the congestion of the area as well. A highlighted site plan can be see below, showing the project in green, and other restricted areas in red, which are either buildings or public roads. Due to these site issues, a major concern for the project team is the lack of material lay down and delivery space. This presents a problem for contractors needing to order material in time for installation. Since there is minimal space for material staging, specific lead times need to be monitored and deliveries need to be scheduled in advance. This could result in materials potentially arriving late on site, since they may not be able to be ordered early. In some instances, when material staging is absolutely necessary, nearby storage units are rented to temporarily store materials. This action is avoided when possible, but is compensated for by the owner when necessary. When major deliveries are made, the GC assembles a crew for a swift and safe unload. Flaggers direct traffic around parked delivery trucks, un-loaders transport materials from the truck to the loading dock, and a material hoist operator coordinates the deliveries to the appropriate floor. Each of these processes is time sensitive and needs to be completed efficiently. The longer a delivery takes, the longer traffic congestion exists, the loading dock is occupied, and construction workers are unable to use the material hoist to transport tools and personnel.

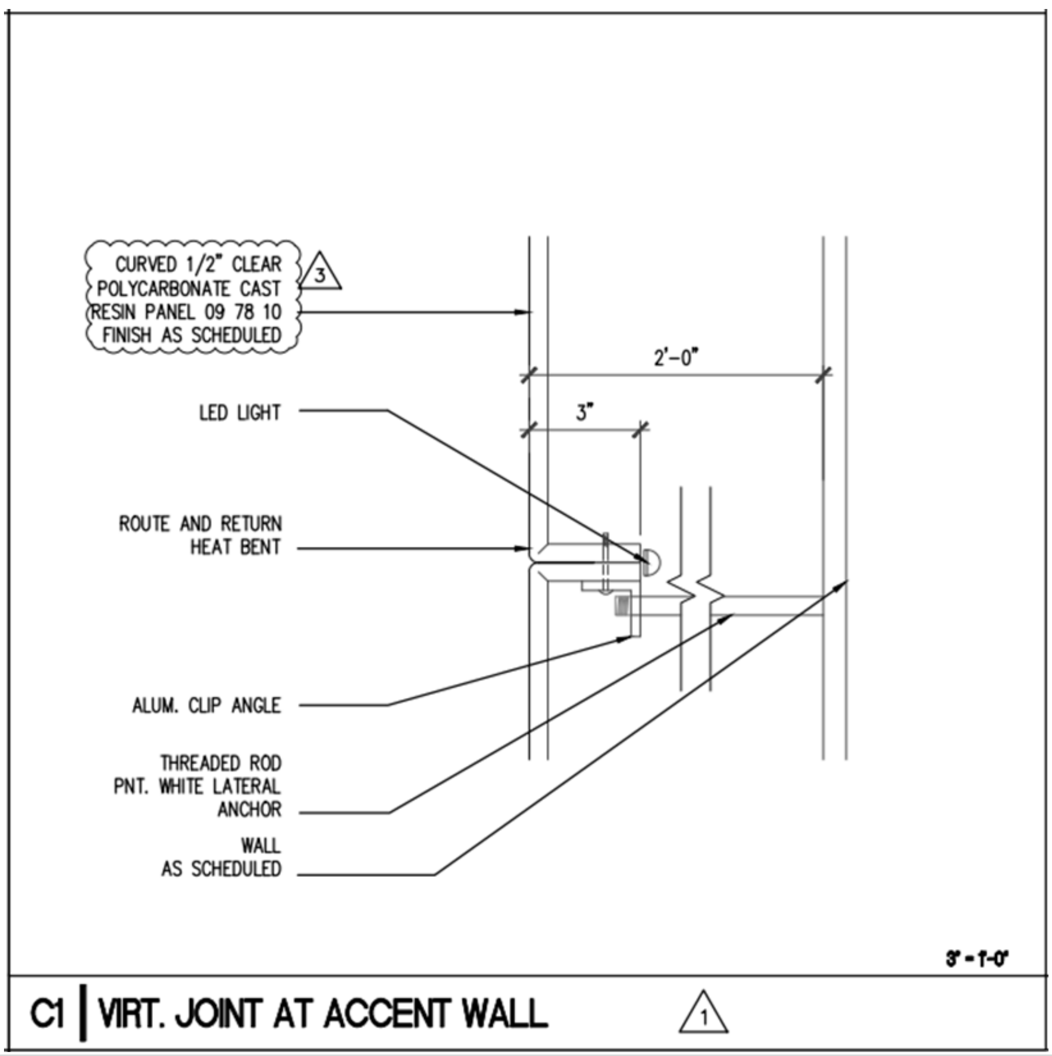
With tight site conditions and neighbors, many protection methods must be put in place to shield the outside from construction dangers. Neighboring parking garage columns have received wood protection from construction, and an elevated partition has been installed to shield a nearby one story restaurant. These constraints, as well as limited parking, provide challenges for the project team, which can be solved by specific coordination of deliveries, staging, and vehicle and equipment parking.



Feature Wall

A common architectural theme to the hospital is a creative wall assembly located throughout the building, mostly in the North West corner of each floor. These curved walls are comprised of brightly colored panels which are illuminated by internal lights. A feature wall made of similar panels was designed for the main entrance of the first floor. During an early mock up phase for the wall, it was discovered by the wall installer that its purpose and function was not achievable. The architect's vision of the finished product was challenged by a poor structural design and lack of illumination by interior LED lights. The unconventional support frame was not strong enough to support the architectural panels, and light from the LED was having trouble making its way through the panels. Although there was not a stringent scheduled completion date for the wall, a solution to the design needed to be made. The figure below shows a detail of this feature wall, its LED light, and its structural elements.

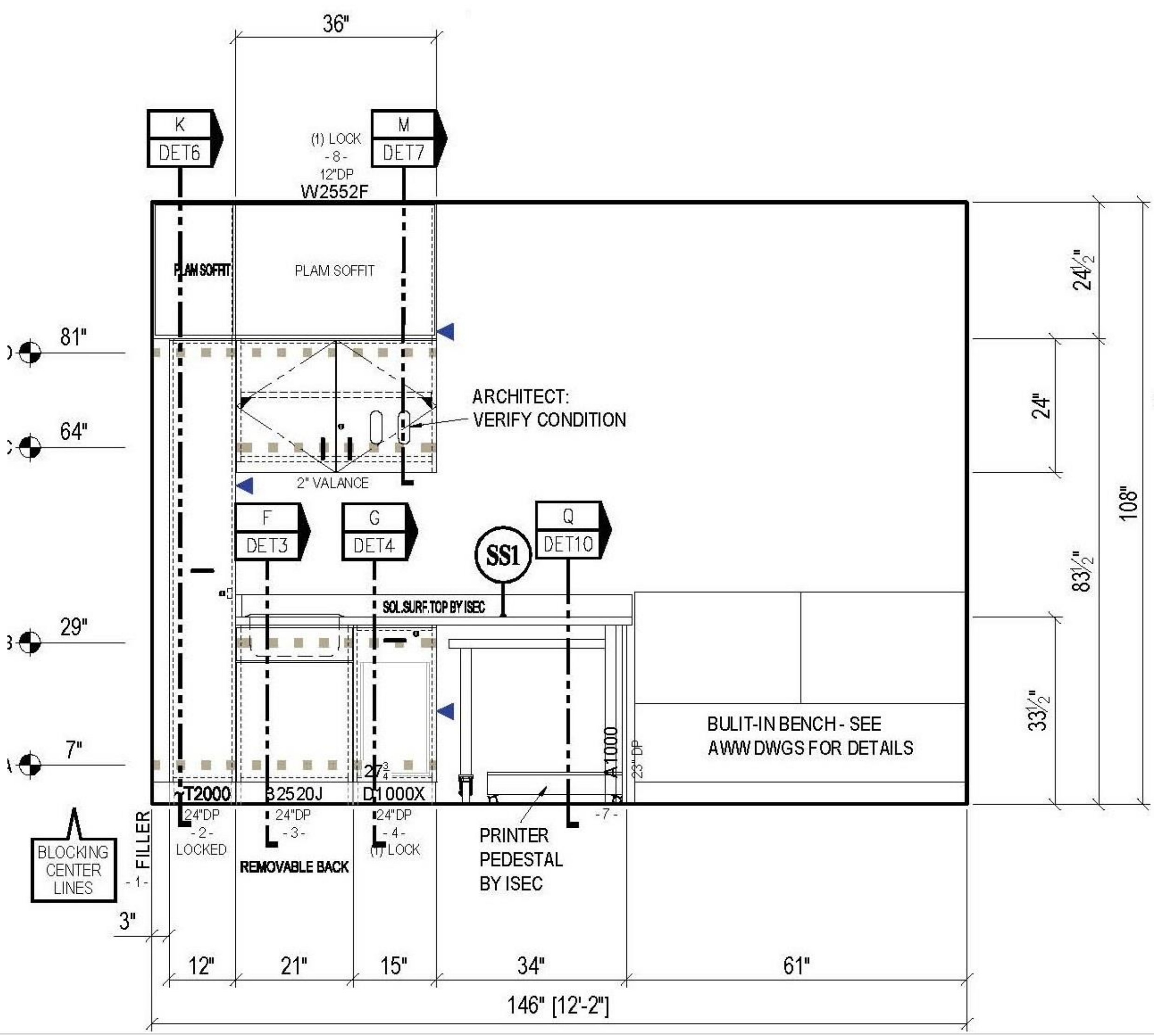
A great deal of input from both the architect and the installation team eventually led to a feasible plan. A redesign was proposed for the structural frame, and is currently being manufactured. New simpler structural brackets have been designed to hold the architectural panels and new LED lights will be arranged differently.



Exam Room Ceiling Height

The drawing below shows an elevation of a typical exam room found on the fourth floor. As listed, the total height of the room is to be 108", from finished floor to ceiling grid. In preparation for cabinet installation, a crew measured the height of a few exam rooms and determined that the ceiling height was approximately 107 ½" – 107 ¾". This would make the elevation impossible to fit since the soffit and tall cabinet were already manufactured to match the 108" design. Furthermore, this mistake would delay the installation of all casework in the exam rooms, because the soffit and tall cabinets would need to be the first elements to be installed, with the Built-In Bench being last. The error could have been due to a slightly unleveled floor, or possibly a miscalculation of the future finished floor thickness.

To solve the problem either the ceiling grid would have to be raised or the base board of the tall cabinet would have to be trimmed down. It was important to make the project team aware of the error immediately, so that the same mistake would not happen to the remaining rooms where ceiling grid was not yet installed. The solution was to raise the ceiling grid to the appropriate height, since this method was cheaper than trimming each cabinet base.



LEED Evaluation

Sustainable Sites				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
1.0	Site Selection	Mandatory	The site is centered around similar functioning buildings and is being built on an existing parking lot in an urban setting.	1
2.0	Development Density & Community Connectivity	Mandatory	Building will add to an already dense city block, and will connect with the community by means of heath care and site friendly attributes.	3
4.1	Alt. Transportation/Access	Mandatory	Street parking is limited near site and traffic is often congested in town. Bus stops and lanes offer a more efficient means of transportation.	2
4.2	Alt. Transportation: Bike Storage & Changing Rooms	Significant	Bike racks promote biking to work which can limit the amount of cars on local roads and prevent the need for rare parking spots.	1
4.3	Alt. Transportation/Vehicles	Minimal	Incentives for electric or fuel efficient vehicles include closer parking spaces to hospital entry.	1
4.4	Alt. Transportation/Parking	Minimal	With an already limited amount of parking, other means of transportation can be implemented, including carpooling.	1
5.1	Site Development: Protect of Restore Habitat	Minimal	A green roof will provide most of the sites vegetated area. Since building is on an existing parking lot, minimal habitat was destroyed.	1
5.2	Site Development: Maximize Open Space	Minimal		0
6.1	Storm water Design: Quantity Control	Mandatory		0
6.2	Storm water Design: Quality Control	Mandatory	Most of building surroundings are impervious and there is heavy foot traffic in area. Storm water must be efficiently managed.	1
7.1	Heat Island Effect: Non-Roof	Mandatory		0
7.2	Heat Island Eddect: Roof	Minimal	A small portion of the roof is green. The remainder of the roof will be protected by high SRI material to limit heat absorbsion.	1
8.0	Light Pollution Reduction	Minimal		0
				12

Category Highlights and Variations from Project Approach

Development Density and Community Connectivity may be responsible for up to three of the twelve credits in the sustainable sites category. A great opportunity to achieve this credit exists with this particular project because of its dense geographical location and its direct relationship with the children and adults of the community. Alternate public transportation access also contributes to this category. Limited street parking and busy local streets make bus and shuttles systems very effective. Either form of transportation must has an access point to the site location within ¼ mile, which is already in existence.

Water Efficiency				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
1.0	Water Efficient Landscaping: Reduce by 50%	Minimal	The Reduction of water consumption will come from other sources of site irrigation.	1
3.0	Water Use Reduction: 30-40%	Minimal	This broad category is attainable through means of efficient toilets, faucets, and other building water sources.	2
				3
Energy and Atmosphere				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
1.1-1.21	Optimize Energy Performance	Significant	A building energy simulation will be needed to determine how efficient the hospital is. The results determine how many points are awarded.	10
2.1-2.7	On-Site Renewable Energy	Significant	Harnessing energy from the buildings surroundings can reduce the cost of building operations.	1
3.0	Enhanced Commissioning	Mandatory	The careful and precise commissioning of the buildings systems ensures the quality of assembly and performance.	2
4.0	Enhanced Refrigerant Management	Minimal	This credit minimizing harmful refrigerants in the building's cooling system.	1
6.0	Green Power	Mandatory	Involves purchasing renewable off grid power, which ultimately aids is the further production of renewable energy throughout the country.	2
				16
Materials and Resources				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
Pre. Req.	Storage & Collection of Recyclables	Mandatory		0
2.1	Const. Waste Manage: Divert 50-75% from Disposal	Significant	Diverting at least 50% of construction materials from a land fill earns points for this credit.	2
4.0	Recycled Content:10-20%	Minimal	Points are earned is at least 10% of total costs of materials are that of recycled content.	2
5.1	Regional Materials	Minimal	Materials must be harvested and manufactured within a 500 mile radius of the project's location.	2
6.0	Rapidly Renewable Materials	Minimal		0
7.0	Certified Wood	Minimal	50% of wood based materials used in the hospital must be FSC certified.	1
				7

Category Highlights and Variations from Project Approach

A large chunk of the points that lead to accreditation come from the optimizing Energy Performance credit. This credit deals with the reduction of energy used in multiple building systems such as office appliances, escalators and elevators, medical equipment, and kitchen appliances. To achieve 10 points in this category, a 30% cost savings from a baseline building performance rating must be achieved. Green Power contributes to LEED certification but does not directly affect the building itself. However, this credit is beneficial to the future production of sustainable power throughout the country, as it provides sponsorship and funding for green power projects such as wind mills and photovoltaic systems.

Indoor Environmental Quality				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
Pre. Req.	Minimum IAQ Performance	Mandatory		0
Pre. Req.	Environmental Tabaco Smoke Control	Mandatory		0
1.0	Outdoor Air Delivery Monitoring	Minimal	Monitoring systems make sure ventilation design requirements are being met.	1
2.0	Increased Ventilation	Significant	Additional outdoor air ventilation will improve indoor air quality and promote occupant comfort.	1
3.1	Const. IAQ Mgmt. Plan: During Construction	Mandatory	A management plan for construction will help the project team from project commencement, and will outline protocol for future issues.	1
3.2	Const. IAQ Management Plan: Before Occupancy	Mandatory	A management plan for building finishes will be established to clean and prepare the building's systems before building turnover.	1
4.1	Low-Emitting Materials: Adhesives & Sealants	Mandatory	This credit is meant to improve the indoor air quality for building occupants	1
4.2	Low-Emitting Materials: Paints & Coatings	Mandatory	Green Seal Standards outline how paints are to be applied in the hospital in order to contribute to better indoor air quality.	1
4.3	Low-Emitting Materials: Carpet Systems	Mandatory	Carpeting Standards outline guidelines for carpet installation in order to contribute to better indoor air quality.	1
4.4	Low-Emitting Materials: Wood & Agrifiber Products	Mandatory	Wood must not contain any added formaldehyde resins in order to contribute to better indoor air quality.	1
5.0	Indoor Chemical & Pollutant Source Control	Mandatory	A system is put in place to minimize and control the flow of contaminants in a building.	1
6.1	Controllability of Systems: Lighting	Minimal	90% of building occupants must have individual lighting controls.	1
6.2	Controllability of Systems: Thermal Comfort	Minimal	50% of building occupants must have individual heating and cooling controls.	1
7.1	Thermal Comfort: Design	Minimal	A monitoring system must be installed to monitor the buildings performance.	1
7.2	Thermal Comfort: Ventilation	Minimal	A monitoring system must be installed to verify if comfort levels are being met.	1
				13

Category Highlights and Variations from Project Approach

Each credit in this category has a limit of one point. Many types of Low-Emitting Materials such as paints, carpets, and wood products are suggested in this category. Since the building type is a hospital, many of these standards are considered mandatory by the owner, and the credit criteria must be met.

Innovation and Design Process				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
	Comprehensive Recycling Program	Minimal	A specific recycling program within the hospital can extend to the immediate surrounding community, promoting sustainability to building occupants as well as neighbors.	1
	Education & Outreach	Minimal	A credit is earned for the implementation of an education system that teaches the effects of sustainability inside and outside of the hospital.	1
	Medical & Process Equipment Efficiency	Minimal	This state of the art hospital can benefit from sustainable equipment that has a long life cycle expectancy.	1
	Exterior Noise, Acoustical Finishes & Noise Levels	Minimal	Better noise protect can shield the hospital from nearby traffic and an area that is often under new construction and renovation.	1
2.0	LEED Accredited Professional	Mandatory	Having at least one LEED A.P. on the project team helps ensure that certification is achieved appropriately.	1
				5
Regional Priority				
Credit Number	**Credit Name**	**Credit Classification**	**Credit Description**	**Credits**
1.0	Regional Priority	Minimal	The project location is in an area with similar building types. Its function is essential to the surrounding community.	1
			Total Proposed Credits	57

Category Highlights and Variations from Project Approach

The Innovation and design category gives the project team an opportunity to use less conventional methods to each LEED points. The team may be creative in the approach and use strategies that pertain to their specific building. The areas that were chosen for further exploration are listed above, and a small explanation for each is listed under “Credit Description”.

A total of 57 points are proposed for the project score. This is slightly higher than the actual proposed project score of 51. Both point totals satisfy a Silver Certification, 50-59 points, which is required for this project.

Appendix

Concrete Beam Schedule and Totals

	Length (in)	Width (in)	Height (in)	Cubic in.	Cubic Ft	Cubic yds.
Beams						
4B1	360	36	48	622080	360.0	13.3
4B2	360	40	21	302400	175.0	6.5
4B3	360	40	21	302400	175.0	6.5
4B4	360	32	21	241920	140.0	5.2
4B5	360	21	21	158760	91.9	3.4
4B6	360	8	21	60480	35.0	1.3
4B7	360	8	21	60480	35.0	1.3
4B8	360	8	21	60480	35.0	1.3
4B9	360	8	21	60480	35.0	1.3
4B10	360	8	21	60480	35.0	1.3
4B11	360	24	21	181440	105.0	3.9
4B12	360	8	21	60480	35.0	1.3
4B13	360	8	21	60480	35.0	1.3
4B14	360	8	21	60480	35.0	1.3
4B15	360	8	21	60480	35.0	1.3
4B16	360	8	21	60480	35.0	1.3
4B17	360	23	25	207000	119.8	4.4
4B18	360	8	21	60480	35.0	1.3
4B19	360	8	21	60480	35.0	1.3
4B20	360	8	25	72000	41.7	1.5
4B21	240	8	21	40320	23.3	0.9
4B22	120	20	21	50400	29.2	1.1
4B23	360	8	21	60480	35.0	1.3
4B24	360	8	21	60480	35.0	1.3
4B25	360	8	25	72000	41.7	1.5
4B26	240	8	21	40320	23.3	0.9
4B27	120	8	21	20160	11.7	0.4
4B28	360	8	21	60480	35.0	1.3
4B29	360	8	21	60480	35.0	1.3
4B30	360	32	25	288000	166.7	6.2
4B31	120	8	21	20160	11.7	0.4
4B32	360	8	21	60480	35.0	1.3
4B33	360	8	21	60480	35.0	1.3
4B34	360	21	25	189000	109.4	4.1
4B35	120	22	21	55440	32.1	1.2
4B36	360	21	21	158760	91.9	3.4
4B37	360	25	21	189000	109.4	4.1
4B38	360	34	25	306000	177.1	6.6
4B39	360	22	27	213840	123.8	4.6
4B40	360	8	21	60480	35.0	1.3
4B41	360	8	21	60480	35.0	1.3
4B42	360	8	21	60480	35.0	1.3
4B43	360	27	25	243000	140.6	5.2
4B44	360	8	21	60480	35.0	1.3
4B45	360	8	21	60480	35.0	1.3
4B46	360	26	27	252720	146.3	5.4
4B47	360	21	25	189000	109.4	4.1
4B48	360	8	21	60480	35.0	1.3
4B49	360	25	21	189000	109.4	4.1

Figure 1

Concrete Beam Schedule and Totals cont.

4B50	360	8	21	60480	35.0	1.3
4B51	360	21	25	189000	109.4	4.1
4B52	360	8	21	60480	35.0	1.3
4B53	360	23	21	173880	100.6	3.7
4B54	360	8	21	60480	35.0	1.3
4B55	360	21	25	189000	109.4	4.1
4B56	360	8	21	60480	35.0	1.3
4B57	360	8	21	60480	35.0	1.3
4B58	360	8	21	60480	35.0	1.3
4B59	360	34	25	306000	177.1	6.6
4B60	360	8	21	60480	35.0	1.3
4B61	360	8	21	60480	35.0	1.3
4B62	360	8	21	60480	35.0	1.3
4B63	360	21	25	189000	109.4	4.1
4B64	360	8	21	60480	35.0	1.3
4B65	360	8	21	60480	35.0	1.3
4B66	360	8	21	60480	35.0	1.3
4B67	360	21	25	189000	109.4	4.1
4B68	360	8	21	60480	35.0	1.3
4B69	360	8	21	60480	35.0	1.3
4B70	360	8	21	60480	35.0	1.3
4B71	360	21	25	189000	109.4	4.1
4B72	360	8	21	60480	35.0	1.3
4B73	360	8	21	60480	35.0	1.3
4B74	360	8	21	60480	35.0	1.3
4B75	360	21	25	189000	109.4	4.1
4B76	360	8	21	60480	35.0	1.3
4B77	360	8	21	60480	35.0	1.3
4B78	360	8	21	60480	35.0	1.3
4B79	360	34	25	306000	177.1	6.6
4B80	360	8	21	60480	35.0	1.3
4B81	360	8	21	60480	35.0	1.3
4B82	144	8	21	24192	14.0	0.5
4B83	360	8	21	60480	35.0	1.3
4B84	84	21	21	37044	21.4	0.8
4B85	120	22	21	55440	32.1	1.2
4B86	240	24	21	120960	70.0	2.6
4B87	180	8	21	30240	17.5	0.6
4B88	360	8	21	60480	35.0	1.3
4B89	84	8	21	14112	8.2	0.3
4B90	180	8	21	30240	17.5	0.6
4B91	360	8	21	60480	35.0	1.3
4B92	84	8	21	14112	8.2	0.3
4B93	180	8	21	30240	17.5	0.6
4B94	360	8	21	60480	35.0	1.3
4B95	84	18	21	31752	18.4	0.7
4B96	120	8	21	20160	11.7	0.4
4B97	120	12	21	30240	17.5	0.6
4B98	120	8	21	20160	11.7	0.4
4B99	120	8	21	20160	11.7	0.4
4B100	189	12	21	47628	27.6	1.0

Figure 2

Concrete Beam Schedule and Totals cont.

4B101	264	21	21	116424	67.4	2.5
4B102	360	21	21	158760	91.9	3.4
4B103	84	18	21	31752	18.4	0.7
4B104	120	22	21	55440	32.1	1.2
4B105	180	22	21	83160	48.1	1.8
4B106	180	22	21	83160	48.1	1.8
4B107	24	8	21	4032	2.3	0.1
4B108	180	12	21	45360	26.3	1.0
4B109	120	8	21	20160	11.7	0.4
4B110	120	8	21	20160	11.7	0.4
4B111	240	18	21	90720	52.5	1.9
4B112	360	36	25	324000	187.5	6.9
4B113	240	12	21	60480	35.0	1.3
4B114	288	33	30	285120	165.0	6.1
4B115	295	32	30	283200	163.9	6.1
4B116	300	42	30	378000	218.8	8.1
4B117	306	32	30	293760	170.0	6.3
4B118	312	42	30	393120	227.5	8.4
4B119	318	32	30	305280	176.7	6.5
4B120	324	42	30	408240	236.3	8.8
4B121	330	32	30	316800	183.3	6.8
4B122	336	42	30	423360	245.0	9.1
4B123	342	32	30	328320	190.0	7.0
4B124	348	42	30	438480	253.8	9.4
4B125	354	32	30	339840	196.7	7.3
4B126	360	42	30	453600	262.5	9.7
4B127	366	30	30	329400	190.6	7.1
4B128	372	21	30	234360	135.6	5.0
4B129	120	29.5	21	74340	43.0	1.6
4B130	360	48	30	518400	300.0	11.1
4B131	360	48	30	518400	300.0	11.1
4B132	360	48	30	518400	300.0	11.1
4B133	204	22	21	94248	54.5	2.0
4B134	360	40	36	518400	300.0	11.1
4B135	360	40	30	432000	250.0	9.3
4B136	360	40	30	432000	250.0	9.3
4B137	120	36	36	155520	90.0	3.3
4B138	300	34	21	214200	124.0	4.6
4B139	300	21	21	132300	76.6	2.8
4B140	300	21	21	132300	76.6	2.8
4B141	300	24	21	151200	87.5	3.2
4B142	240	23	21	115920	67.1	2.5
4B143	240	8	21	40320	23.3	0.9
4B144	360	40	36	518400	300.0	11.1
4B145	360	36	21	272160	157.5	5.8
4B146	360	36	21	272160	157.5	5.8
4B147	360	30	21	226800	131.3	4.9
4B148	360	30	21	226800	131.3	4.9
4B149	144	12	21	36288	21.0	0.8
4B150	144	16	21	48384	28.0	1.0

Figure 3

Concrete Beam Schedule and Totals cont.

4B151	24	12	21	6048	3.5	0.1
4B152	24	12	21	6048	3.5	0.1
4B153	120	36	21	90720	52.5	1.9
4B154	360	36	21	272160	157.5	5.8
4B155	360	36	27	349920	202.5	7.5
4B156	360	35	21	264600	153.1	5.7
4B157	360	36	21	272160	157.5	5.8
4B158	30	16	21	10080	5.8	0.2
4B159	30	12	21	7560	4.4	0.2
4B160	45	12	21	11340	6.6	0.2
4B161	30	12	21	7560	4.4	0.2
4B162	360	36	25	324000	187.5	6.9
4B163	360	36	25	324000	187.5	6.9
4B164	360	36	25	324000	187.5	6.9
4B165	360	36	21	272160	157.5	5.8
4B166	360	36	36	466560	270.0	10.0
4B167	360	36	25	324000	187.5	6.9
4B168	360	30	25	270000	156.3	5.8
4B169	360	30	21	226800	131.3	4.9
4B170	45	12	25	13500	7.8	0.3
4B171	30	12	25	9000	5.2	0.2
4B172	32	12	25	9600	5.6	0.2
4B173	37	12	25	11100	6.4	0.2
4B174	60	12	25	18000	10.4	0.4
4B175	65	12	25	19500	11.3	0.4
4B176	55	12	25	16500	9.5	0.4
4B177	70	12	25	21000	12.2	0.5
4B178	70	12	25	21000	12.2	0.5
4B179	70	12	25	21000	12.2	0.5
4B180	75	12	25	22500	13.0	0.5
4B181	65	12	25	19500	11.3	0.4
4B182	70	12	25	21000	12.2	0.5
4B183	65	12	25	19500	11.3	0.4
4B184	70	12	25	21000	12.2	0.5
4B185	65	12	25	19500	11.3	0.4
4B186	60	12	25	18000	10.4	0.4
4B187	60	12	25	18000	10.4	0.4
4B188	170	19	21	67830	39.3	1.5
4B189	65	20	21	27300	15.8	0.6
4B190	65	18	21	24570	14.2	0.5
4B191	65	12	21	16380	9.5	0.4
4B192	120	18	21	45360	26.3	1.0
4B193	240	8	21	40320	23.3	0.9
4B194	120	8	25	24000	13.9	0.5
4B195	168	18	21	63504	36.8	1.4

Figure 4

Concrete Column Schedule and Totals

	Length (in)	Width (in)	Height (in)	Cubic in.	Cubic Ft	Cubic yds.
Columns						
A.6/8	16	16	168	43008	24.9	0.9
XSI/3	24	24	168	96768	56.0	2.1
XSI/4	24	24	168	96768	56.0	2.1
XSI/5	24	24	168	96768	56.0	2.1
XSI/6	24	24	168	96768	56.0	2.1
C/2.1	24	24	168	96768	56.0	2.1
C/5	30	30	168	151200	87.5	3.2
C/6	24	24	168	96768	56.0	2.1
C/7	30	30	168	151200	87.5	3.2
D/2.1	24	24	168	96768	56.0	2.1
D/3.1	24	24	168	96768	56.0	2.1
D/4	24	24	168	96768	56.0	2.1
D/5	24	24	168	96768	56.0	2.1
D/6	24	24	168	96768	56.0	2.1
D/7	24	24	168	96768	56.0	2.1
D6.5/8	16	12	168	32256	18.7	0.7
E/2.1	24	24	168	96768	56.0	2.1
E/3	24	24	168	96768	56.0	2.1
E/4	24	24	168	96768	56.0	2.1
E/5	24	24	168	96768	56.0	2.1
E/6	24	24	168	96768	56.0	2.1
F/2	24	24	168	96768	56.0	2.1
F/3	24	30	168	120960	70.0	2.6
F/4	24	24	168	96768	56.0	2.1
F/5	24	24	168	96768	56.0	2.1
F/6	24	24	168	96768	56.0	2.1
F/8	24	24	168	96768	56.0	2.1
G/2	24	24	168	96768	56.0	2.1
G/3	24	24	168	96768	56.0	2.1
G/4	24	30	168	120960	70.0	2.6
G/5	24	24	168	96768	56.0	2.1
G/6	30	30	168	151200	87.5	3.2
G.4/3	24	16	168	64512	37.3	1.4

Figure 5

Concrete Grade Beam Schedule and Totals

	Length (in)	Width (in)	Height (in)	Cubic in.	Cubic Ft	Cubic yds.
Grade Beams						
GB 1	120	72	36	311040	180.0	6.7
GB 2	360	72	36	933120	540.0	20.0
GB 3	360	72	36	933120	540.0	20.0
GB 4	360	72	36	933120	540.0	20.0
GB 5	144	72	36	373248	216.0	8.0
GB 6	360	60	36	777600	450.0	16.7
GB 7	216	60	36	466560	270.0	10.0
GB 8	300	60	36	648000	375.0	13.9
GB 9	360	60	36	777600	450.0	16.7
GB 10	360	60	36	777600	450.0	16.7
GB 11	360	60	36	777600	450.0	16.7
GB 12	360	60	36	777600	450.0	16.7
GB 13	180	60	36	388800	225.0	8.3
GB 14	180	60	36	388800	225.0	8.3
GB 16	180	48	36	311040	180.0	6.7
GB 17	360	48	36	622080	360.0	13.3
GB 18	144	48	36	248832	144.0	5.3
GB 19	144	48	36	248832	144.0	5.3
GB 20	360	48	36	622080	360.0	13.3
GB 21	360	48	36	622080	360.0	13.3
GB 22	348	48	36	601344	348.0	12.9
GB 23	348	48	36	601344	348.0	12.9
GB 24	132	48	36	228096	132.0	4.9
GB 25	132	48	36	228096	132.0	4.9
GB 26	180	48	36	311040	180.0	6.7
GB 27	360	72	36	933120	540.0	20.0
GB 28	180	72	36	466560	270.0	10.0
GB 29	120	72	36	311040	180.0	6.7
GB 30	108	72	36	279936	162.0	6.0
GB 31	108	72	36	279936	162.0	6.0

Figure 6

Caissons	Depth (ft)	Surface (sf)	Cubic ft	Cubic yds.	Total CY
88	34	15.7	533.8	19.8	1739.8

Figure 7

Caisson Caps	Length (ft)	Width (ft)	Height (ft)	Cubic ft	Cubic yds.	Total CY
88	3	3	1	9	0.33	29.3

Figure 8

Foundation walls	Depth (ft)	Width (ft)	Height (ft)	Cubic ft	Cubic yds.
	0.75	742	17	9460.5	350.4

Figure 9

Slab			
Sq. ft.	thickness	cu ft.	cu yrds
24197.86	0.4167	10083.248	373.45364

Figure 10

Steel Reinforcing Totals

Rebar in Beams					
Qty	**Bar Size**	**Length (ft)**	**Wt. (lb/ft)**	**lb/qty**	**Cubic yds.**
344	#4	22.2	0.668	14.8	5101.4
20	#5	22.2	1.043	23.2	463.1
55	#6	22.2	1.502	33.3	1833.9
221	#7	22.2	2.044	45.4	10028.3
116	#8	22.2	2.67	59.3	6875.8
66	#9	22.2	3.4	75.5	4981.7
22	#10	22.2	4.303	95.5	2101.6
8	#11	22.2	5.313	117.9	943.6

Figure 11

Grade Beam Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
72	#11	253	5.313	1344.2	96781.61
50	#8	253	2.67	675.5	33775.5
44	#10	253	4.303	1088.7	47901
66	#9	253	3.4	860.2	56773.2

Figure 12

Slab on Grade Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
576	#4	190	0.668	126.92	73105.92
515	#4	170	0.668	113.56	58483.4

Figure 13

Caisson cap Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
704	#4	15	0.668	10.0	7054.1

Figure 14

Foundation Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
17	#6	742	1.502	1114.484	18946.228
17	#7	742	2.044	1516.648	25783.016
890	#8	17	2.67	45.39	40397.1

Figure 15

Steel Reinforcing Totals cont.

Caisson Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
136	#8	34	2.67	90.8	12346.1
206	#10	34	4.303	146.3	30138.2
578	#11	34	5.313	180.6	104411.1
8976	#4	15	0.668	10.0	89939.5

Figure 16

Column Rebar					
Qty	Bar Size	length (ft)	Wt. (lb/ft)	lbs	Total lb
264	#8	14	2.67	37.38	9868.32
495	#4	5	0.668	3.34	1653.3

Figure 17