Tech Assignment #2

"Cost and Methods Analysis"

Widener University, New Residence Hall

10/31/2005

Kevin Engel

Advisor:
Dr. Messner

Construction Manager:
HSC Builders
304 New Mill Lane
Exton, PA 19341

Executive Summary:

The objective of the tech 2 assignment was to create a detailed project schedule, perform both a detailed and an assemblies estimate, create a layout plan for a construction phase, and estimate general conditions costs for the project. The schedule lays out exactly when each of the trades should expect to be on site and what they need to accomplish to keep the project on schedule. Overall the schedule appears logical and it leaves some room for resource balancing. This is probably to allow the trades and the superintendent to coordinate this in the field during construction.

The detailed estimate showed that the structural system for this building should cost $1.85 million. After considering the type of building and the cost of the interiors, this seems to be in the range that would be expected. The assemblies estimate gives a cost of $1.63 million for the electrical system of the building. At 11% of the building cost, this seems reasonable.

The general conditions estimate gives a cost of $737,485. The project lasts about 16 months total, but the office trailer and staff will only be there for 12 months of this time because they are not needed while the well field is being drilled. The staff cost is 74% of the general conditions. Although it is normal for staff to be most of the general conditions cost, this is higher than I expected, especially when there is a total of 8 weeks of crane time on the job.

Detailed Project Schedule:

The schedule shown in Figure 2 is the construction manager's expected schedule for the project. It is broken down into sitework, structural, first floor, second floor, third floor, fourth floor, and building envelope to make it easier to see what work is to be in progress on any given day. The flow of work is typical, with the building divided between the two wings of the L-shape and by floors. Obviously, the foundations and rough site work are completed first, followed by structural elements. Then rough-in work is completed from the bottom to top. Finally, the finishing trades will back out of the building, starting on the fourth floor and working their way down to the first floor and out of the building, with the final landscaping completed after all other construction tasks are finished. Currently the project is a few days behind schedule because of the unexpected amount of rain the area has received. The project is expected to come back on schedule at the end of the precast plank activities because there are a few extra days built into this activity to account for any unexpected delays or problems.

Assemblies Estimate:

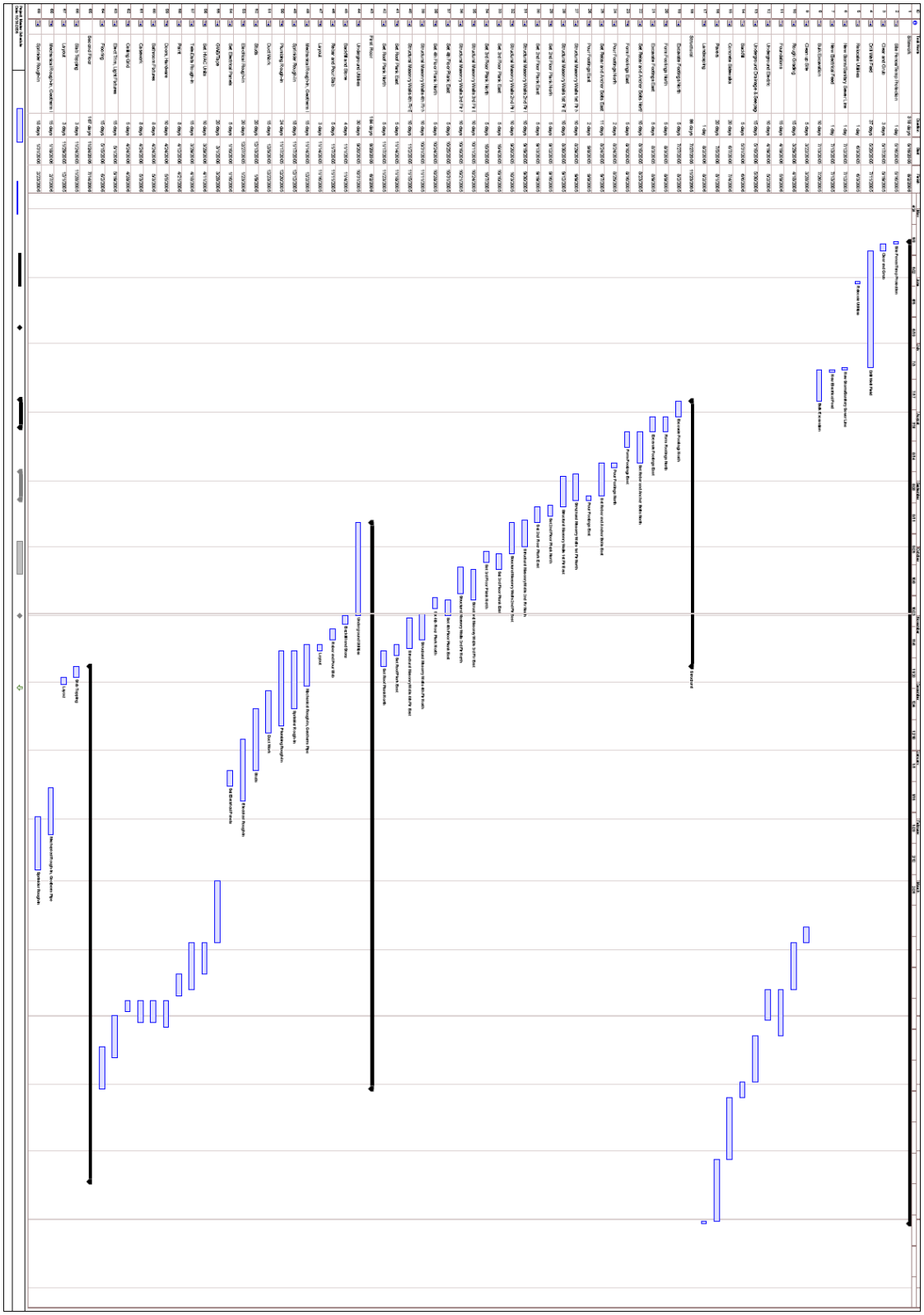
The electrical system was chosen for the assemblies estimate. Figure 1 shows the costs and quantities for each component of the system. These costs were taken from R.S. Means data. They appear to be reasonable; however the actual cost was not available for comparison. For a $14.5 million building the electrical system cost of $1.63 million is 11% of the total cost, within the 10-15% range expected.

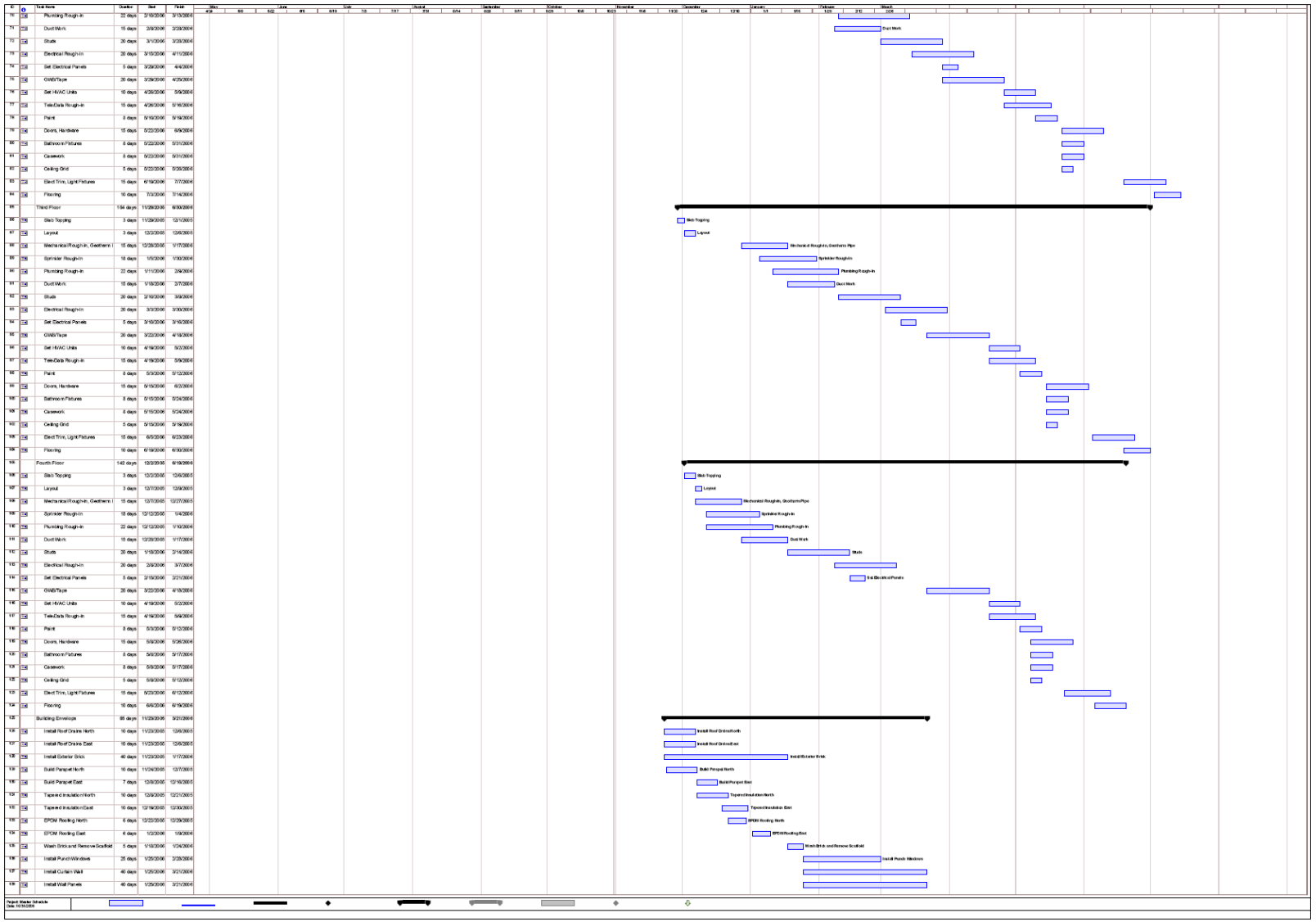
Figure 1. Assemblies Estimate Information

Electrical System Assemblies Estimate			mat	inst	total	total w/ O&P	Quantity	Total Cost
Per L.F.	Feeder	15kV conductors in 4" conduit	32	28	60	76.20	145	11049.00
Each	Service Connection	Service instal, breakers, metering, conduit, wire	875	900	1775	2254.25	1	2254.25
Each	switchgear	switchgear instal, swbd, panels, & circ brkr, 120/208V	3575	3050	6625	8413.75	2	16827.50
Per S.F.	Receptacles	Plate, box, conduit, distribution & transformer	0.41	1.09	1.5	1.91	90000	171450.00
Per S.F.	Lighting	Type B flourescent w/wire and conduit distribution	4.26	6.3	10.56	13.41	90000	1207008.00
Per kW	Generator	Gen set, battery, charger, muffler, & transfer switch	248	42	290	368.30	100	36830.00
						Electrical System Total		$1,445,418.75
						Area Factor		1.13
						Project Total =		$1,633,323.19

Assemblies Estimating Checklist/Format Guide	
	Show all appropriate assemblies for your selected system
	Modify assemblies as appropriate to match your project conditions
	Clearly show the summary of your estimate in a condensed format, categorized by CSI Uniformat II
	Add appropriate markups and modifications to standard estimating manual data
	Include overall units for easy comparison of your estimate results to similar projects, e.g., $/cy for concrete, $/ton for steel, $/sf of façade for enclosure
	Submit a copy of your takeoff notes with the summary
	Clearly define any assumptions

Figure 2. Detailed Construction Schedule




ID
Task Name
Duration
Start
Finish
Plumbing Rough-In 22 days 2/16/2006 3/15/2006
Duct Work 15 days 2/9/2006 2/28/2006
Studs 20 days 3/1/2006 3/28/2006
Electrical Rough-In 20 days 3/15/2006 4/11/2006
Set Electrical Panels 5 days 3/28/2006 4/4/2006
GWB/Tape 20 days 3/29/2006 4/25/2006
Set HVAC Units 10 days 4/26/2006 5/9/2006
Tele-Data Rough-In 15 days 4/26/2006 5/16/2006
Paint 8 days 5/16/2006 5/26/2006
Doors, Hardware 15 days 5/22/2006 6/9/2006
Bathroom Fixtures 8 days 5/22/2006 5/31/2006
Casework 8 days 5/22/2006 5/31/2006
Ceiling Grid 5 days 5/22/2006 5/26/2006
Elect Trim, Light Fixtures 15 days 6/19/2006 7/7/2006
Flooring 10 days 7/3/2006 7/14/2006
Third Floor 194 days 11/28/2005 8/30/2006
Slab Topping 3 days 11/28/2005 12/1/2005
Layout 3 days 12/2/2005 12/6/2005
Mechanical Rough-In, Geotherm I 15 days 12/28/2005 1/17/2006
Sprinkler Rough-In 10 days 1/5/2006 1/30/2006
Plumbing Rough-In 22 days 1/11/2006 2/9/2006
Duct Work 15 days 1/18/2006 2/7/2006
Studs 20 days 2/16/2006 3/9/2006
Electrical Rough-In 20 days 3/3/2006 3/30/2006
Set Electrical Panels 5 days 3/16/2006 3/16/2006
GWB/Tape 30 days 3/22/2006 4/19/2006
Set HVAC Units 10 days 4/19/2006 5/2/2006
Tele-Data Rough-In 15 days 4/19/2006 5/9/2006
Paint 8 days 5/3/2006 5/12/2006
Doors, Hardware 15 days 5/15/2006 6/2/2006
Bathroom Fixtures 8 days 5/15/2006 5/24/2006
Casework 8 days 5/15/2006 5/24/2006
Ceiling Grid 5 days 5/15/2006 5/19/2006
Elect Trim, Light Fixtures 15 days 6/5/2006 6/23/2006
Flooring 10 days 6/19/2006 6/30/2006
Fourth Floor 142 days 12/2/2005 6/19/2006
Slab Topping 3 days 12/2/2005 12/6/2005
Layout 3 days 12/7/2005 12/9/2005
Mechanical Rough-In, Geotherm I 15 days 12/7/2005 12/27/2005
Sprinkler Rough-In 15 days 12/12/2005 1/4/2006
Plumbing Rough-In 22 days 12/12/2005 1/10/2006
Duct Work 15 days 12/28/2005 1/17/2006
Studs 20 days 1/18/2006 2/14/2006
Electrical Rough-In 20 days 2/9/2006 3/7/2006
Set Electrical Panels 5 days 2/15/2006 3/21/2006
GWB/Tape 30 days 3/22/2006 4/18/2006
Set HVAC Units 10 days 4/19/2006 5/2/2006
Tele-Data Rough-In 15 days 4/19/2006 5/9/2006
Paint 8 days 5/3/2006 5/12/2006
Doors, Hardware 15 days 5/8/2006 5/26/2006
Bathroom Fixtures 8 days 5/8/2006 5/17/2006
Casework 8 days 5/8/2006 5/17/2006
Ceiling Grid 5 days 5/8/2006 5/12/2006
Elect Trim, Light Fixtures 15 days 5/23/2006 6/12/2006
Flooring 10 days 6/6/2006 6/19/2006
Building Envelope 86 days 11/28/2005 3/21/2006
Install Roof Drains North 10 days 11/23/2005 12/6/2005
Install Roof Drains East 10 days 11/23/2005 12/6/2005
Install Exterior Brick 40 days 11/23/2005 1/17/2006
Build Parapet North 10 days 11/24/2005 12/7/2005
Build Parapet East 7 days 12/8/2005 12/16/2005
Tapered Insulation North 10 days 12/8/2005 12/21/2005
Tapered Insulation East 10 days 12/19/2005 12/30/2005
EPDM Roofing North 6 days 12/23/2005 12/29/2005
EPDM Roofing East 6 days 1/2/2006 1/9/2006
Wash Brick and Remove Scaffold 5 days 1/18/2006 1/24/2006
Install Punch Windows 25 days 1/25/2006 2/28/2006
Install Curtain Wall 40 days 1/25/2006 3/21/2006
Install Wall Panels 40 days 1/25/2006 3/21/2006
Project: Master Schedule
Date: 10/31/2005

Structural Detailed Estimate:

The total cost for the structure of this building is estimated to be $1.85 million, as shown in Figure 3. This is 12.8% of the total building cost. This would seem low, but the cladding for the building is nearly all brick, and the interior finishes are expected to cost more than on most buildings due to almost all of the floors being carpet. Another thing that may cause the structure to be less expensive than in most buildings is the shallow foundation system. The foundation system has also eliminated formwork by using the soil as the form. The takeoff notes and R.S. Means Pricing information are included as Appendix A.

Figure 3. Structural Estimate Totals

Structural Estimate Totals	
TOTAL CIP CONCRETE	$141,193.96
TOTAL MASONRY COST	$591,882.92
TOTAL PRECAST COST	$818,893.88
TOTAL STEEL COST	$84,600.26
Structural Total	$1,636,571.02
Area Factor	1.13
Structural Project Total =	$1,849,325.25

	Detailed Estimating Checklist/Format Guide
	Perform detailed takeoff of structural system(show takeoff notes)
	Price items with standard estimating manual or database
	Include clear summary of results organized by CSI Masterformat
	Add appropriate markups and modifications to standard estimating manual data
	Include overall units for easy comparison of your estimate results to similar projects, e.g., $/cy for concrete, $/ton for steel, $/sf of façade for enclosure
	Clearly define any assumptions

General Conditions Estimate:

Figure 4 shows the expected costs of general conditions for this project. As expected the largest cost is the staffing of the project. Some of the other notable costs are the crane and cleanup at the end of the project.

Figure 4. General Conditions Estimate

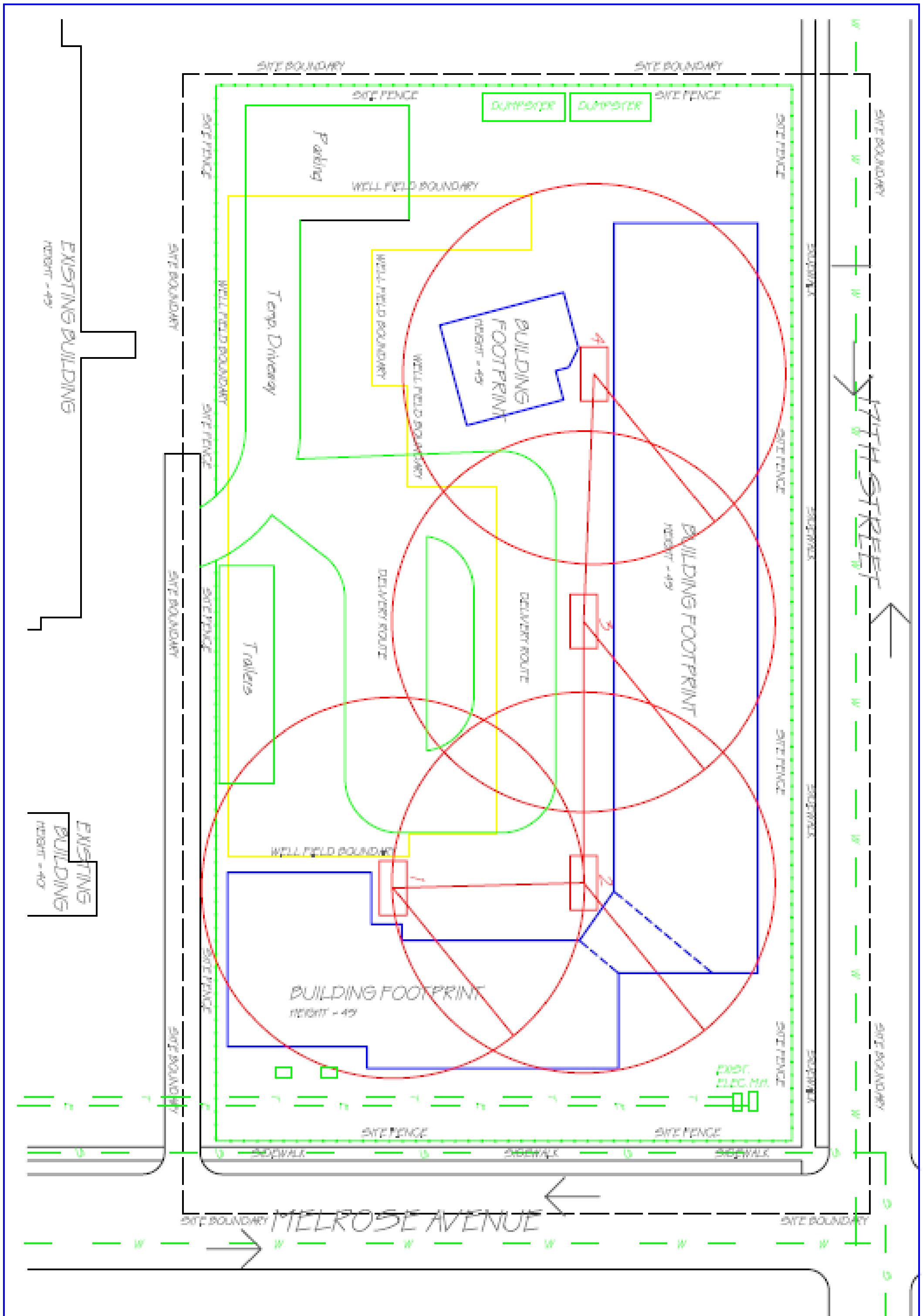
General Conditions Costs	Units	Quantity	Material	Labor	Equipment	Total	Total w/O&P	Project Total
Senior P.M	Week	32		1850.00		1850.00	2875.00	92000.00
P.M	Week	64		1625.00		1625.00	2525.00	161600.00
Assist. P.M.	Week	64		995.00		995.00	1550.00	99200.00
Superintendent	Week	56		1500.00		1500.00	2325.00	130200.00
32x8 Trailer	Month	12	163.00			163.00	180.00	2160.00
A/C 5 months	Month	5	39.50			39.50	43.50	217.50
Site Fence	L.F.	1200	4.48	1.42		5.90	7.15	8580.00
Testing	Job	1					33100.00	33100.00
Telephone	Month	12	204.00			204.00	224.00	2688.00
Temp. Roads	S.Y.	1676	3.23	1.89	0.30	5.42	6.80	11396.80
Crane	Week	8		incl	6950.00	6950.00	8500.00	68000.00
Cleanup	% Job Cost	14500000					0.00	43500.00
							TOTAL	$652,642.30
							Area Factor	1.13
							Project G.C. Total	$737,485.80

Site Layout Planning:

The structural phase of the project was chosen for the site layout plan. This seemed to be the most interesting part of the project because there is a crane on site and there will need to be a lot of deliveries of precast plank. Please see the next page for the site layout.

A mobile crane will need to be used for this project to lift the pre-cast planks into place. This crane is shown with a 70 foot reach inside a circle. 4 set-up locations have been defined for the crane. You will notice that these locations do not cover the entire building. This is because covering the entire building is not necessary due to the exterior walls being masonry walls. The crane only needs to reach to the center of the planks for the far side of the building. As shown this requirement will be met.

You may also notice that the well field boundary has objects on top of it. This well field takes up a lot of space because of the 72 wells spaced a minimum of 7’ from each other. General traffic over the area will not damage the well system because the entire geothermal well field is buried a minimum of 4’6” from the surface. This amount of cover will protect the system from all surface loads. However, it would still not be a good idea to place a loaded crane on top of it because this may be a load the designers have not considered due to its unusual nature.



PROJECT WIDENER UNIVERSITY
NEW RESIDENCE HALL

TITLE TECH 1: EXISTING CONDITIONS

CLASS THESIS

DRAWN BY KEVIN ENGEL

DATE 09-05 | SCALE 1/64" = 1'

DRAWING NO. 1 OF 1

PENNSTATE ARCHITECTURAL ENGINEERING

APPENDIX A:

CIP Detailed Estimate

Strip Footings	width	depth	conc. Cy/ft	steel wt/ft	Length(ft.)	material	Labor	Equip.	total	total w/O&P	Total Cost
F20.12	24"	12"	0.074	2.67	415	8.36	5.62	0.04	14.02	18.00	7470.00
F36.12	3'6"	12"	0.13	4.9	688	12.09	6.83	0.04	18.96	23.92	16456.96
F50.14	5'	14"		11.47	239	4.36	3.33	0.00	7.69	10.32	2466.48
			0.216		239	17.50	9.72	0.06	27.28	34.37	8215.10
F66.16	6'6"	16"		17.47	139	6.64	5.07	0.00	11.71	15.72	2185.08
			0.321		139	26.00	14.45	0.09	40.54	51.08	7100.18
F66.36	6'6"	36"		146.81	112	52.85	24.59	0.00	77.44	99.00	11088.00
			0.722		112	58.48	32.49	0.21	91.18	114.89	12867.32
											$67,849.12

Col Footings	size	depth	conc. Cy	steel wt	Number	material	Labor	Equip.	total	total w/O&P	Total Cost
F30	3'x3'	12"	0.333		1	26.97	14.99	0.10	42.05	53.41	53.41
				25.03	1	9.51	7.26		16.77	21.30	21.30
F40	4'x4'	12"	0.593		6	56.13	31.19	0.20	87.52	111.15	666.89
				41.72	6	15.85	12.10		27.95	35.50	213.00
F50	5'x5'	12"	0.926		8	75.01	41.67	0.27	116.94	148.52	1188.16
				62.58	8	23.78	18.15		41.93	53.25	425.99
F86	8'6"x8'6"	18"	4.01		5	324.81	180.45	1.16	506.42	643.16	3215.79
				347.48	5	132.04	100.77		232.81	295.67	1478.35
F100120	10'x12'	26"	9.63		3	780.03	433.35	2.79	1216.17	1544.54	4633.62
				816	3	293.76	136.68		430.44	546.66	1639.98
F5080	5'x8'	18"	2.22		1	179.82	99.90	0.64	280.36	356.06	356.06
				190.09	1	72.23	55.13		127.36	161.75	161.75
											$14,054.29

Piers	size	Total (ft.)	conc. Cy	steel wt		material	Labor	Equip.	total	total w/O&P	Total Cost
P1	20" x 20"	86.5	0.103			8.34	4.64	0.03	13.01	16.52	1428.98
		86.5		18.79		7.14	5.45		12.59	15.99	1383.00
P2	26" x 26"	11	0.174			14.09	7.83	0.05	21.97	27.91	306.98
		11		27.72		10.53	8.04		18.57	23.59	259.46
											$3,378.42

Slab on Grade	s.f.					material	Labor	Equip.	total	total w/O&P	Total Cost
5"	2176					1.31	0.67	0.01	1.99	2.43	5287.68
4"	18693					1.07	0.65	0.01	1.73	2.15	40189.95
6x6 W1.4xW1.4 W	208.69	c.s.f.				19.35	17.35	0	36.7	50	10434.50
											$55,912.13

CIP CONCRETE TOTAL $141,193.96

Grouting First Floor Walls

Exterior	11	640	7040	0.85	1.44	0.2	2.49	3.34	23513.60
Interior	11	810	8910	0.85	1.44	0.2	2.49	3.34	29759.40
								Total	$53,273.00

8" CMU

Exterior	10.33	1876	19379.08	2.48	3.55		6.03	8.15	157939.50
Exterior	10.67	938	10008.46	2.48	3.55		6.03	8.15	81568.95
Interior	10.33	1620	16734.6	1.63	3.45		5.08	7.05	117978.93
Interior	10.67	810	8642.7	1.63	3.45		5.08	7.05	60931.04
Exterior	11	640	7040	2.48	3.55		6.03	8.15	57376.00
Interior	11	810	8910	1.63	3.45		5.08	7.05	62815.50
								Total	$538,609.92

TOTAL MASONRY COST $591,882.92

Precast Plank			
Width(ft)	Length(ft)	# Pieces	S.F.
8	15	32	3840
8	18.67	32	4779.52
8	18	32	4608
8	12	4	384
8	14	4	448
8	11	4	352
8	23	48	8832
8	22	28	4928
8	33	40	10560
8	32	16	4096
8	15	16	1920
8	23.5	28	5264
8	30.5	28	6832
8	23	56	10304
8	30	56	13440
8	15.5	16	1984
8	21.5	16	2752
8	15.5	36	4464
8	14	8	896
8	19.5	8	1248
8	19	20	3040
8	19	21	3192
8	28	18	4032
8	11.25	9	810
		Total	103005.5

Precast Hollow Plank, 8" thickness						
mat	lab	equip	total	total w/O&P	Total S.F.	Total Cost
5.45	0.84	0.45	6.74	7.95	103005.5	$818,893.88

Columns									
	Number	Shape	# floors	mat	labor	equip	total	total w/O&P	Total Cost
C1	2	HSS 10x10x5/8	2	950	43	27.5	1020.5	1150	4600.00
	2	HSS 10x10x1/2	2	950	43	27.5	1020.5	1150	4600.00
C2	1	HSS 8x8x5/8	2	950	43	27.5	1020.5	1150	2300.00
	1	HSS 8x8x5/8	2	950	43	27.5	1020.5	1150	2300.00
C4	2	HSS 4x4x5/16	4	144	35.5	23	202.5	246	1968.00
C5	11	W10 x 60	4	65.5	2.1	1.35	68.95	77	3388.00
C7	2	HSS 6x6x5/16	5	236	38.5	24.5	299	370	3700.00
C8	4	W10 x 39	3	42	1.97	1.25	45.22	58	696.00
								Total	$23,552.00

Lintels									
	# Lintels	Shape	Pcs/Lintel	mat	labor	equip	total	total w/O&P	Total Cost
W8 x 31	4		1	30	3.76		36.17	42	168.00
L1	19	5x3	2	43	27		70	89	3382.00
L2	1	4x3	2	43	27		70	89	178.00
L2B	10	4x3	3	64.5	40.5		105	133.5	4005.00
L2C	5	4x3 & 6x3	3	64.5	40.5		105	133.5	2002.50
L3	7	6x3	2	78	47		125	158	2212.00
L3B	12	6x3	3	117	70.5		187.5	237	8532.00
L4	12	7x4	2	85.8	51.7		137.5	173.8	4171.20
								Total	$24,650.70

Structural Shapes								
	Length(ft.)		mat	labor	equip	total	total w/O&P	Total Cost
W8 x 24	24		23	3.76	2.41	29.17	34.5	828.00
W12 x 16	18		13.5	2.35	1.51	17.36	20.5	369.00
W12 X 19	102		21	2.35	1.51	24.86	29	2958.00
W12 X 22	38.5		21	2.35	1.51	24.86	29	1116.50
W12 x 30	30		33.5	2.56	1.64	37.7	43	1290.00
W12 x 45	16		48	2.76	1.77	52.53	59.5	952.00
W12 X 50	11		48	2.76	1.77	52.53	59.5	654.50
W14 X 22	29.33		25	2.09	1.34	28.43	32.5	953.23
W14 x 26	47		25	2.09	1.34	28.43	32.5	1527.50
W14 x 61	78		71	2.72	1.74	75.46	85	6630.00
W16 X 36	14.67		38.5	2.59	1.66	42.75	49	718.83
HSS 10X8X5/16	16		950	43	27.5	1020.5	1150	18400.00
							Total	$36,397.56

TOTAL STEEL COST $84,600.26